MANUAL OF HYGIENE



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FOR USE IN INDIA

BY

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PREFACE

THIS small Manual of Hygiene was originally intended for use in Upper Primary Schools in India. The task of writing it was undertaken by the author at the request of the late Surgeon-General Harvey, Director-General of the Indian Medical Service. It is hoped that in its present form, which is perhaps more advanced than it was originally intended to be, the Manual may meet the requirements of University students and others who are beginning to study the subject of Hygiene. The author desires to express his warmest thanks to Mr. James W. Furrell, late editor of the *Calcutta Review*, and to Captain Leonard Rogers of the Indian Medical Service, officiating Professor of Pathology and Bacteriology, Medical College, Calcutta, for many valuable suggestions made by them for the improvement of the Manual during its preparation.

CHARLES BANKS.

CALCUTTA, *February*, 1902.

DEDICATED TO

H. H. RISLEY, C.I.E.

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"OFFICIER" OF THE FRENCH ACADEMY AND

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SOCIETY

INTRODUCTION.

Out of every hundred deaths occurring in India seventy-eight are said to be due to disease, which can be to a very large extent, or altogether, prevented. During the ten years 1890 to 1899 over forty-three millions of people are reported to have died in India from fevers, cholera and other bowel complaints, and small-pox, all of which are more or less preventible. Nearly five million deaths, from these diseases and plague, occurred among the general population during the year 1899. Millions of people in India either, through ignorance, cannot grasp the idea, or are deliberately unwilling to be convinced that the real cause of such diseases is to be found in the air they breathe, the water they drink, the food they eat; that it may be conveyed in their clothing, in their skin, in their breath, and in the discharges from their bodies. They cannot understand, moreover, how the spread of disease can in any way be influenced by social customs, habits, mode of living, surroundings, the structure and situation of their dwellings, by overcrowding, or by climate. Outbreaks of disease are regarded by them as their *kismet* or fate, or as judgments of gods and goddesses, or the work of evil spirits. Prayers, fastings, sacrifices, street processions, and other religious ceremonies are resorted to in the belief that they are the most effectual means whereby the ravages of the disease may be stayed. Reliance upon measures such as these always, however, ends in disaster. The disease spreads rapidly, panic ensues, people fly from their homes in their frantic effort to escape being attacked, and thus

carry the disease with them in their persons and belongings to other places. Business comes to a stand-still. Poverty, misery, and distress prevail, and in many instances death ends it all. If people were only wise and would take kindly to those measures which Science has shown to be the best that can be adopted in dealing with outbreaks of epidemic disease, panic, riots, and dislocation of the affairs of the country generally would not take place, and a vast amount of poverty, sickness, and death would be prevented.

A more general knowledge of the laws of health would help considerably to bring about this happy state of affairs. It is with the view of imparting some information on this important subject that this Manual of Hygiene has been written.

DEFINITIONS.

Hygiene. The term hygiene is derived from a Greek word, *hygieia*, which means health. A knowledge of this subject teaches us how to live, where to live, what food to eat and what to avoid, what water is safe to drink and what is dangerous and unfit for use. It also teaches us how to construct our houses, and the dangers of living in dirty and overcrowded houses and localities. It enables us to select the kind and quality of clothing we should wear, and the kind and amount of exercise best suited for us. It teaches us that rest is required for both body and mind, the value of sleep, the evils of the use of alcohol, tobacco, opium, cocaine, and many other debilitating drugs. Hygiene, in short, tells us what to do in order to prevent disease and keep our bodies in an active and healthy state. This branch of the subject is known as Personal Hygiene or Personal Health.

Sanitation. The term sanitation is often used instead of hygiene. The term sanitation is, however, more

correctly applied to the means taken to protect the health of the general public and not that of individuals. This has been called Public Hygiene or Public Health. Public Hygiene deals with the construction of houses, the making and cleaning of roads, drains, sewers, latrines, stables, and cattle-sheds, and the disposal of all kinds of refuse in towns and villages. It also deals with the supply of water and the prevention of the pollution of water and air, and the adulteration of food supplies. Public health has also to do with the notification of infectious diseases, the measures needed to prevent them from spreading, and the registration of births and deaths.

GENERAL FUNCTIONS OF THE BODY

Before beginning the study of Hygiene proper it is necessary to know something about the general functions of the body.

The human body, then, has been regarded as a machine which has to do certain kinds of work or perform certain functions. These functions are (1) **motion and locomotion**; (2) **nutrition**, which includes the digestion of food, respiration or breathing, the circulation of the blood, etc.; (3) **reproduction** in order to prevent the human race from becoming extinct; and (4) regulation of these various functions by the nervous system, to which the term **innervation** has been applied. Even the lowest forms of life, which are composed of single cells, possess these characters in a greater or less degree. *Cell* is the name given to the ultimate unit of living matter. A cell is a small particle of semi-fluid living substance, or *protoplasm*, the outer surface of which may sometimes become sufficiently firm to form a limiting-membrane or *cell-wall*. It nearly always contains a denser kernel-like body or *nucleus*.

THE HUMAN SKELETON.

The human skeleton forms the frame-work of the body, and is composed of more than 200 separate bones. For the purpose of description it may be divided into three portions, namely, the head, trunk, and limbs. (Fig. 1.)

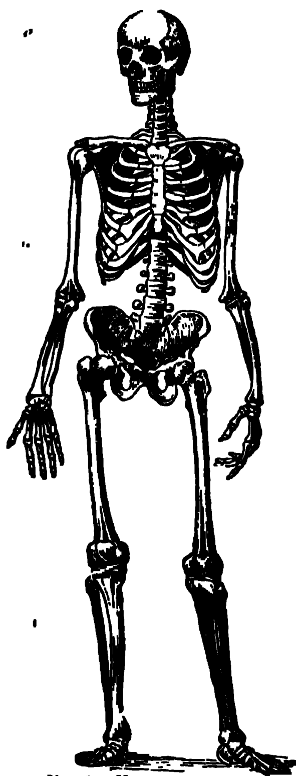


FIG. 1.—HUMAN SKELETON.

The Head, or Skull is composed of 22 bones, of which the face contains 14. The skull forms a cavity for the protection of the brain, which is the most important part of the nervous system.

The Trunk. The trunk consists of the spine or back-bone, the ribs, and the breast-bone.

The Spine (Fig. 2) has also been called the vertebral column, because it is made up of small bones called vertebræ, of which there are 33 in the spine in infancy. In grown-up people the last nine vertebræ grow together and form two bones called the sacrum and the coccyx respectively. The former is made up of five and the latter of four vertebræ.

The vertebræ have been classified as cervical, or those found in the neck, which are seven in number;

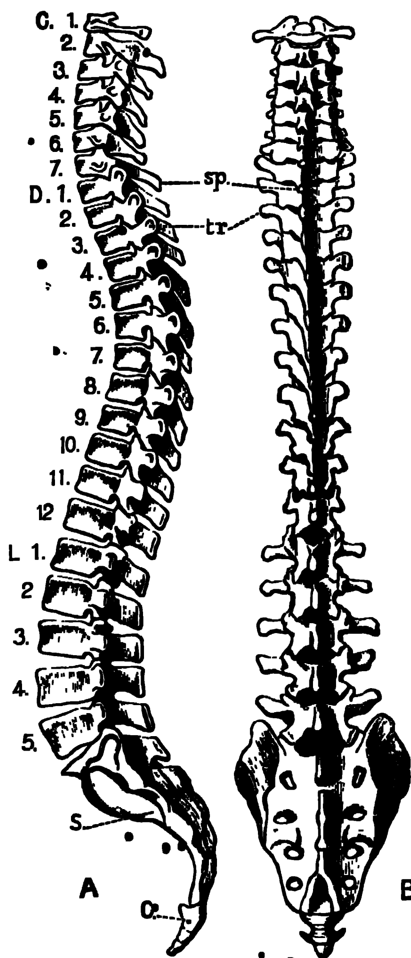


FIG. 2.—THE VERTEBRAL COLUMN.

A, side view, left side; B, back view; C 1-7, cervical vertebræ; D 1-12, dorsal vertebræ; L 1-5, lumbar vertebræ; S, sacrum; C, coccyx; sp, spinous processes; tr, transverse processes.

dorsal, to which the ribs are attached, which are twelve in number; and loin or lumbar vertebræ, which are five in number. The sacrum and coccyx come next in order. The spine forms a strong pillar for the support of the head, on which heavy weights are sometimes carried. The small bones of which the spine is made are kept together by means of structures called muscles and ligaments. In order to prevent injury to the spine from falls or sudden jerks small rings of an elastic substance called cartilage are interposed between the vertebræ. The structure of the spine also enables us to walk, bend our bodies, and maintain an erect posture. Running through nearly the entire length of the spine is a canal or tube, called the vertebral canal, for the protection of an important part of the nervous system connected with the brain, called the spinal cord, which is contained within it.

The Ribs. The ribs, which are twelve in number on either side, the breast-bone, and that portion of the spine to which the ribs are attached form what is called the thorax or chest cavity. (Fig. 3.)

The first seven ribs are connected with the breast-bone by means of long pieces of cartilage. The next three are attached to each other by similar means and indirectly to the breast-bone. The last two ribs have no connection with each other, or with the other ribs or breast-bone, and are therefore called free or floating ribs. The chest walls have thus been constructed in such a way as to give the greatest freedom of movement and at the same time to protect the important structures contained in the chest cavity, namely, the heart, lungs, and large blood-vessels connected with them.

Limbs. The limbs consist of the arms and legs, and are spoken of as the upper and lower limbs or extremities respectively. Each upper limb includes the shoulder-blade,

collar-bone, arm, forearm, and hand; each lower limb includes the haunch-bone, thigh-bone, knee-cap, leg, and foot. The shoulder possesses great freedom of movement. The arm, however, possesses still greater freedom of move-

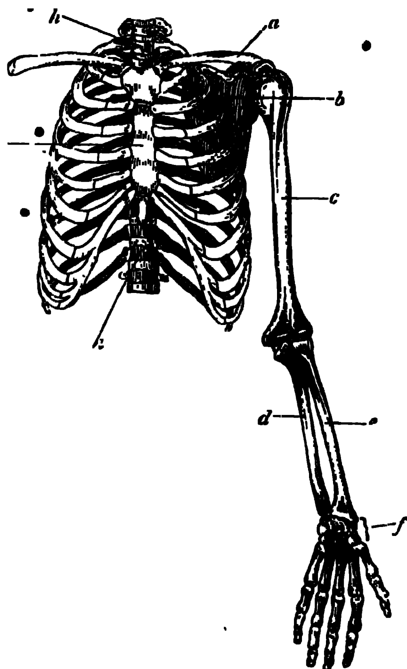


FIG. 3.—THORAX, SHOULDER GIRDLE, AND UPPER EXTREMITY.
a, clavicle; *b*, scapula; *c*, humerus; *d*, ulna; *e*, radius; *f*, carpus; *g*, sternum; *h*, bodies of vertebræ.

ment, because the head of the arm-bone (humerus) is round and works in a cup-shaped socket in the shoulder-blade, thus forming what is called a ball and socket joint. The fore-arm contains two bones (radius and ulna), which enable us, by means of the muscles attached to them, to direct the

palm of our hands downwards (pronation) or upwards (supination) at pleasure. The wrist has eight, the palm five, and the fingers have fourteen small bones. These are called the carpal, metacarpal, and phalangeal bones respectively. The upper limbs have been called the faithful ministers of the mind. The haunch-bones are the strongest bones of the body, and form with the sacrum a cavity called the pelvis, which means a basin. The weight of the body is supported chiefly by the haunch-bones, with which the thigh bones have a close relationship, forming with them, as in the case of the shoulder, a ball and socket joint, in which, however, the movements are not so free as in the case of the shoulder. The thigh has a single bone (femur), which is the longest and thickest bone in the body. The leg contains two bones (tibia and fibula) and the foot twenty-six, of which seven are called tarsal, five metatarsal, and fourteen phalangeal bones respectively. The lower limbs are used for the purpose of locomotion.



FIG. 1.—THE MUSCLES.

MUSCLES.

Muscles (Fig. 4) form the fleshy portion of our bodies, and it is by means of them that we are able to stand erect, run, walk, lift weights, and perform most of the ordinary acts of life. They are divided into two kinds, viz., voluntary and involuntary. The voluntary muscles are those which are directly under the control of the will, such as those of

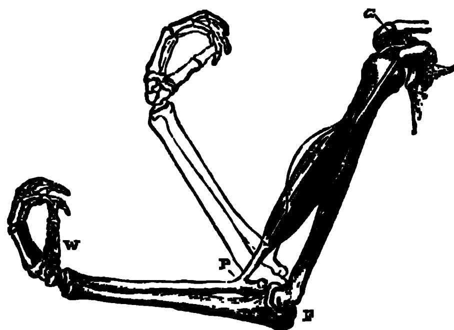


FIG. 5.—DIAGRAM TO SHOW THE ACTION OF THE BICEPS MUSCLE OF THE ARM.

The two tendons by which the muscle is attached to the scapula are seen at *a*; P, the point of attachment of the muscle to the radius; F, the elbow joint; W, the weight of the hand.

the [illegible]ns and [illegible] The involuntary are those which cannot be controlled by the will, as, for example, the muscles of the heart by which it is enabled to beat, of respiration, and of the food pipe and alimentary canal generally, by the action of which food passes downwards into the stomach, where it is rolled about during digestion and afterwards allowed to pass into the small intestines, etc. All these movements are performed without our knowledge, and the muscles which perform them have accordingly been called involuntary muscles. Regular and moderate use of

the muscles causes them to increase in size, while excessive use or disuse has the opposite effect.

NERVOUS SYSTEM.

The nervous system is composed of the brain and spinal cord and the nerves given off by these structures. The brain and spinal cord form what is called the **central nervous system.** Nerves which convey impressions from the special organs of sense, such as light in the case of the eye, sound in the case of the ear, and smell in the

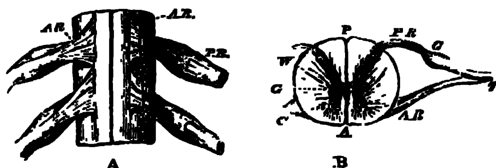


FIG. 6. – A, FRONT VIEW OF A PORTION OF THE SPINAL CORD.

On the left side of the cord the anterior roots, *AR*, are cut to show the posterior roots, *PR*.

B, CROSS SECTION OF THE CORD.

A, anterior fissure; *P*, posterior fissure; *G*, central canal; *C*, grey matter; *W*, white matter; *AR*, anterior root; *PR*, posterior root; *Ga*, ganglion of posterior root; *T* trunk of a spinal nerve.

case of the nose; and impressions from the skin, such as heat and touch, are called afferent nerves. When these impressions reach the central nervous system other nerves come into play. If light, for instance, is too strong, the eyes are immediately shut; or if a thing which is touched is too hot we immediately pull away our hands. These movements, in common with all voluntary movements, are effected by the muscles of our body, and the nerves by which we are able to perform them are called efferent nerves.

The brain and spinal cord consist of nerves and small bodies called centres or ganglion cells, and it is

these cells which receive the different impressions. The spinal cord is about 18 inches long and ½ inch broad. It is composed partly of white and partly of grey-looking matter, the white forming the outside portion and the grey the central portion of the cord. The spinal cord gives off 32 pairs of nerves through openings on either side of the spine, each nerve having two roots.

The spinal nerves not only carry impulses to the spinal cord, but carry impulses to the muscles. The fibres in the spinal nerves which convey impulses to the cord are called sensory, and those which convey impulses to the muscles are called motor fibres. When the spinal cord is injured the motor nerves may not be able to convey impressions to certain parts of the body. Movements and other actions are not then possible, and the injured person is for this reason said to be paralysed.

Reflex actions are those actions which are performed unconsciously or without the action of the will. Many of our actions are performed in this way.

Locomotion to a large extent, and the movement of the lungs in respiration, are examples of actions of this nature.

The Brain (Fig. 7) is a very complicated organ, and consists of very many different and important parts. It is divided into the cerebrum and cerebellum. The former is divided into two portions, one of which is situated in either side of the skull cavity. These are called the cerebral hemispheres, and are connected with each other. Beneath the cerebrum or great brain, as it is also called, and at the back of the skull is the cerebellum or small brain.

The brain is composed of the same substance as the spinal cord, and gives off 12 pairs of nerves called cranial nerves, some of which are the nerves of the special senses, viz., smell, sight, taste, and hearing. Others are for regulating the movements of the muscles of the eyeball and tongue.

Another and very important nerve, called the pneumo-gastric, which consists of both sensory and motor fibres, supplies branches to the lungs, heart, food-pipe, stomach, liver, etc., to enable them to perform their proper functions.

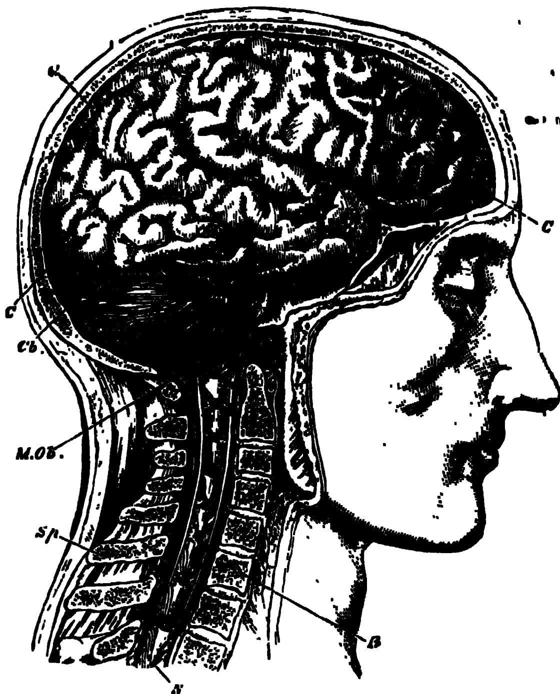


FIG. 7. SIDE VIEW OF THE BRAIN AND UPPER PART OF THE SPINAL CORD.

C, the convoluted surface of the right cerebral hemisphere; *Cb*, cerebellum; *M.Ob*, medulla oblongata; *N*, spinal cord with spinal nerves. *B*, the bodies and *Sp*, the spines of the vertebræ

The Sympathetic Nervous System is a connected chain of ganglia given off by the spinal nerves on either side of the spine. The organs in the belly and chest cavities receive branches from this system. It is the sym-

pathetic system of nerves that supplies the walls of arteries and regulates the amount of blood contained in them.

It is the action of the sympathetic nerve which causes sudden blushing or blanching of the face. The sympathetic system of nerves also regulates the action of the stomach, heart, and other organs in the abdomen and chest to a large extent and helps to maintain the heat of the body.

SECRETION.

In order to understand the meaning of the term secretion it is necessary to know something about the structure of glands, which perform this function. The term gland is derived from the Latin word *glans*, which means an acorn, and is so called from its resemblance to that seed. Glands are composed of small tubes lined with cells.

Some glands are very small and have one tube only, while other glands are of large size and contain many tubes. These small cells manufacture the various substances for the digestion of food, such as the saliva or spittle which is formed in the mouth, and the gastric juice which is formed in the stomach. They also, however, form other substances, such as the milk which is formed in the breast for the nourishment of infants. This is known as secretion.

EXCRETION.

Excretion means the removal from the blood of carbonic acid gas, water, urea, and other waste products which are formed during the performance of the various functions of the body.

Special organs have been provided for this purpose, the chief organs being the lungs, kidneys, and skin.

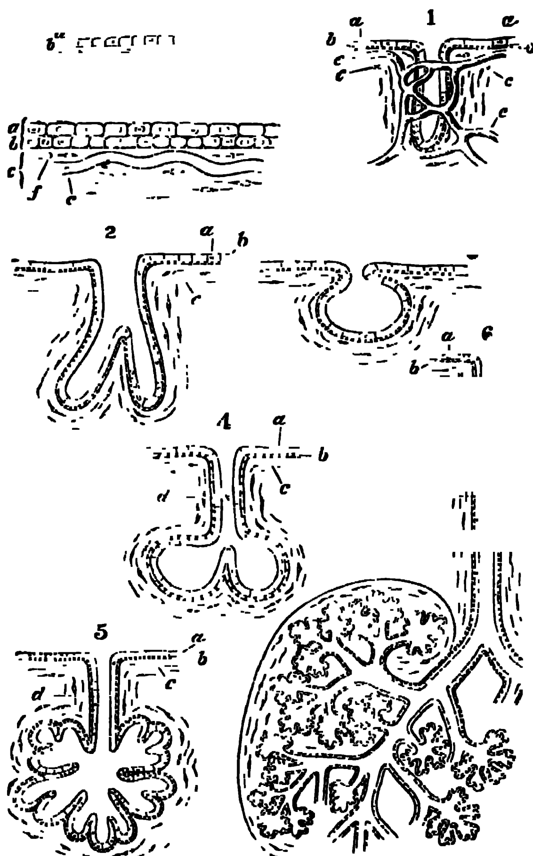


FIG. 8. – DIAGRAM TO ILLUSTRATE THE STRUCTURE OF GLANDS.

A, Typical structure of a mucous membrane with two layers of epithelial cells, *a*, *b*; *c*, the connective tissue beneath, with *e*, blood-vessels and *f*, connective-tissue cells.

B, the same with one layer of cells resting on *b*, the so-called basement membrane. 1, a simple tubular gland; 2, a tubular gland dividing; 3, a saccular gland; 4, a divided saccular gland with duct *d*; 5, a similar gland more divided; 6, a racemose gland, part only being drawn. In Figs. 2-6 the blood-vessels are omitted.

THE KIDNEYS.

The kidneys are two in number, one of which is situated on either side of the body, at the back near the vertebral column and just below the ribs. Both kidneys are supplied with blood-vessels (arteries and veins). Each kidney, moreover, has a tube called the ureter connected with it, which

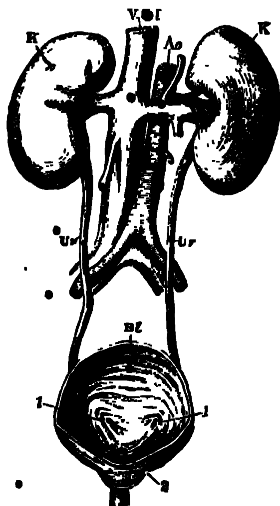


FIG. 9.- THE URINARY ORGANS.

K, kidneys; *Ur*, ureters; *Bl*, bladder; 1, openings of ureters, and 2, opening of urethra in the bladder; *Ao*, aorta; *V.C.I.*, inferior vena cava.

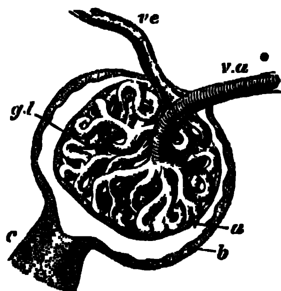


FIG. 10.— A MALPIGHIAN CAPSULE.

v.a, small artery entering and forming the glomerulus *gl*, and finally leaving in a small vein, *v e*; *c*, tubule; *a*, epithelium over the glomerulus; *b*, epithelium lining the capsule.

conveys the waste matter (urine) from the kidney to the bladder, from which it is discharged at intervals.

The minute structure of the kidneys is exceedingly interesting but complicated. It consists of numerous small tubes, each of which is dilated at one end forming a sac or capsule. These are called Malpighian capsules (Fig. 10.)

Inside these capsules are clusters of small arteries and veins called glomeruli.

The urine, which is formed partly in these structures and partly in the cells with which the tubes are lined by a process of filtration and secretion, passes along the small tubes, and ultimately finds its way into the ureter and bladder.

Composition of Urine. Urine is a yellowish coloured fluid consisting chiefly of water and urea. It also, however, contains some chloride of sodium (common salt) and other mineral substances, such as lime and magnesia, and some gases, chiefly carbonic acid gas. From 40 to 60 ounces of urine are excreted daily. The amount excreted, however, depends very much upon the quantity of liquid consumed, and the amount of blood which circulates through the kidneys. During hot weather the skin is unusually active and gives off a large amount of sweat, while the kidneys excrete very little urine indeed. Cold, on the other hand, drives the blood from the skin to the internal organs, and the kidneys in consequence act freely, and a large quantity of urine is eliminated, while the skin hardly acts at all.

THE SKIN.

The Structure of the Skin. The skin consists of two chief layers. The first or outer layer is called the epidermis, cuticle, or scarf skin. This layer is made up of numerous small cells, which vary in shape at different depths. The uppermost cells, which are flat, are being continually cast off. The deepest layer consists of round or cubical cells, and contains pigment or colouring matter. The pigment accounts for the differences in colour of different races of people and the degree of colour in people of different caste or type who belong to the same country. Exposure to great heat causes pigmentation of the skin.

There are no blood-vessels in the epidermis. The second layer, called the dermis, cutis, or true skin, is thick and tough. It is from this layer of the hides of animals that leather is made. The small blood-vessels which nourish the skin, the roots of the hair, and the sweat and oil glands are all found in the dermis. The dermis also contains elastic and connective tissue, and numerous small and

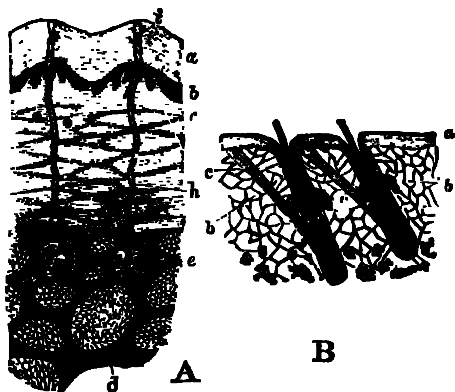


FIG. 11. THE SKIN.

A, Section of skin showing sweat glands. a, epidermis; b, its deeper or Malpighian (pigment) layer; c, d, dermis; f, fat; g, sweat glands; h, ducts; i, opening of duct on surface.

B.—Section of skin showing hairs and sebaceous glands. b, fine muscles connected with the hair sheaths, c.

delicate muscular fibres. When the epidermis or upper layer is rubbed off, the dermis or lower layer bleeds freely.

The Sweat Glands. The sweat glands have openings or pores all over the body. There may be two or three millions of them. They are $\frac{1}{4}$ inch in length and $\frac{1}{300}$ inch in diameter.

The Oil Glands. The oil glands secrete an oil which keeps the skin and hair soft and pliable, and prevents them from becoming dry and unhealthy.

The Elastic Tissue. The elastic tissue in the dermis causes the furrows which appear in the skin in old age.

The Muscular Fibres. The muscular fibres during contraction force the oil out of the oil glands. They also stop the flow of sweat from the sweat glands when the body is exposed to great cold, and in this way help to prevent loss of heat. On the other hand, these small muscles become relaxed during active exercise or exposure to great heat, and more sweat than usual then escapes from the skin. The sweat rapidly evaporates or dries up, and in this way the body is kept cool. If this were not the case the temperature of our bodies would become so great as to make it impossible for us to live.

Perspiration or Sweat. Sweat consists chiefly of water. It also contains some salts and oil. Sweat is acid in its normal condition. When alkaline it smells badly. Two pints or more of sweat escape from our bodies daily. In hot countries the amount is much larger than in cold countries. It is sometimes more than 25 per cent. greater. When much oil is poured out the skin looks dirty and greasy. If we do not keep our skins clean the pores become blocked up, the sweat cannot escape, and the health suffers. Our bodies begin to smell, and people who are cleanly in their habits will object to our presence. Skin diseases are often caused by dirt and neglect.

RESPIRATION.

Inspiration. The air we breathe passes through the nostrils, mouth, threat, and windpipe into the lungs, one of which is situated on either side of the chest. The walls of the chest, as has been shown, are so elastic in their construction that they can easily rise and fall during breathing These movements are effected then, by virtue of the elastic

nature of the chest walls and lungs, and by certain muscles, including those of the neck, chest, and belly. The most important muscle of all, however, is the diaphragm or midriff, which is situated at the lowest part of the chest cavity, and separates it from the abdominal cavity. The action of all these muscles is regulated by the nervous system.

It will be seen from one of the diagrams here given that

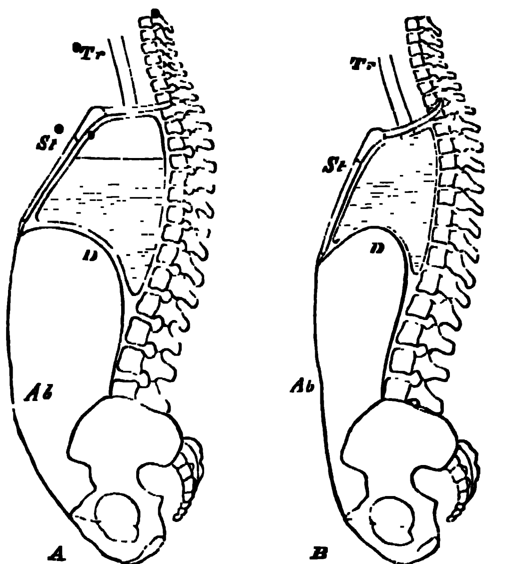


FIG. 12.—DIAG[illegible]M, DIAPHRAGM, AND ABDOMINAL WALL IN RESPIRATION.

A, inspiration; *B*, expiration; *Tr*, trachea; *St*, sternum; *D*, diaphragm; *Ab*, abdominal wall. The shaded part is to indicate the stationary air.

the diaphragm is arch-shaped. During the act of breathing it contracts or draws itself together; the arch slowly loses its curve, the lungs become filled with air, and extend downwards, following closely the descent of the arch of the diaphragm, and at the same time the ribs are pushed out-

wards. The chest thus becomes greatly increased in size. All these movements are performed while taking air into the lungs. This is called "Inspiration." (Fig. 12 *A*.)

Expiration. When the lungs have taken in as much air as they can contain, a short pause ensues. The chest walls then begin to fall slowly. All the movements are exactly the opposite of those which take place during inspiration. This is known as "Expiration." (Fig. 12 *B*.)

Respiration. The combined movements of inspiration and expiration constitute what is called respiration, or breathing. When as much air as possible is forced out of the lung by expiration, that which still remains in it is called residual air. "The air which is left in the lung after an ordinary expiration is called supplemental air. The air comprehended under these names does not leave the lungs, and is therefore called stationary air" (Huxley).

The Structure of the Lungs. In order to be able to understand what happens to the air taken into the lungs, it is necessary to have some idea of their structure. The lungs, then, are composed of what are called air-cells, arranged together like bunches of grapes, as shown in Fig. 13. These bunches of cells are on an average only $\frac{1}{10}$th part of an inch in diameter. Each cell has numerous minute blood-vessels coursing through its walls, which contain impure blood brought from all parts of the body. It has been calculated that if all the cells were spread out they would present a surface measuring about fourteen thousand square feet. We breathe sixteen or seventeen times in the minute, and at each breath the cells become filled with pure air.



FIG. 13.—A SMALL PIECE OF LUNG.

Highly magnified to show the air-cells, *b*; and minute air tube, *a*.

Changes which take place in the Lungs during Respiration. The small blood-vessels in the cell walls are constantly and greedily absorbing or helping themselves to the oxygen contained in the inspired air, and giving off its impurities in the form of carbonic acid gas, watery vapour, and other waste matters. Every time we breathe we take in about three-quarters of a pint (20 to 30 cubic inches) of pure air, and allow the same amount of impure air to escape from the lungs.

DIGESTION.

The object of digestion is to render the food which we eat fit for the nourishment and growth of our bodies. The digested food is absorbed by the small blood-vessels and other structures in the walls of the stomach and intestine.

The Digestive System consists of the mouth, in which are the teeth, tongue, salivary and numerous other small glands which secrete or form the saliva or spittle, the soft palate which forms the back part of the roof of the mouth and ends in the uvula or small tongue-like body which is seen at the back of the throat. The tonsils on either side of the throat, the oesophagus, gullet, or food pipe, which conveys the food to the stomach, the stomach itself, the large and small intestines, the pancreas, and the liver are also included in the digestive system. The digestive system is also called the alimentary system. The route along which the food travels is called therefore the alimentary canal.

Teeth. Teeth begin to appear in infants when they are about six months old. The first set, called the temporary or milk teeth, are twenty in number. The second set, called the permanent teeth, are thirty-two in number. The last of the molars, or wisdom teeth, do not appear until adult life. They may not appear until the age of thirty

years even. The front teeth four in number in each jaw, are called incisors or cutting teeth. Next to them are the canines, which are narrow and blunt-pointed. There is one canine tooth on either side of the incisors in both jaws. Next to the canines on either side and in both jaws are two bicuspids; and, lastly, in grown-up people are three molars or grinders, also on either side in both jaws, situated at the back.

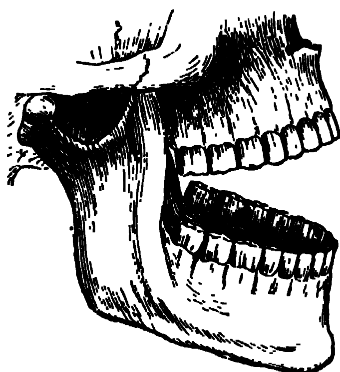


Fig. 14. The Teeth

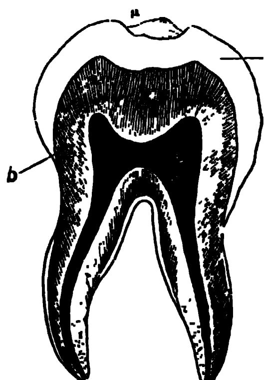


Fig. 15.—Section of Tooth showing Structure. *a*, enamel, *b*, dentine, *c*, cavity.

Teeth have a crown, neck, and fangs. The crown is covered with enamel, which is very brittle because it contains two per cent. only of animal matter. The teeth, however, are made chiefly of a substance called dentine, which is hard like bone, but different in structure. The fangs of teeth are coated with a substance of a bony nature called cement. The inside of the fangs is filled with a substance called pulp, in which are a large number of small branches of blood-vessels and nerves, the main trunks of which enter at the tip of the fangs. This accounts for the severe pain felt in decaying teeth.

The Tongue consists almost entirely of muscular tissue, by means of which it can be moved in every direction. It is by these movements that the food is rolled about in the mouth and mixed with the saliva during mastication or chewing. The tongue is also of great help during the act of swallowing. The small bodies which project from the surface of the tongue, and which are best seen at the back, are called papillae. In the papillae are small delicate structures called taste bodies or taste bulbs. The taste bodies in the papillae in the front and side portion of the tongue are for sweet substances, while those at the back are for bitter.

The Salivary Glands. (Fig. 16.) The glands of the mouth are situated at the angle of the lower jaw, under the jaw, and under the tongue. The mouth is also lined with numerous smaller glands, which secrete a substance called mucus. The larger glands secrete the saliva. The chief constituent of saliva is a ferment, called ptyalin, which converts starch into grape sugar. The saliva also dissolves solid bodies, such as sugar and salt, and, as was stated before, helps us to swallow our food. Over twenty ounces of saliva are secreted daily.



FIG. 16.- DISSECTION TO SHOW THE SALIVARY GLANDS.

a, the sublingual gland, and *b*, the submaxillary, with their ducts opening into the floor of the mouth by the tongue at *d*; *c*, parotid gland with duct opening into the mouth at *e*.

The Œsophagus, Gullet, or Food Pipe is about 10 inches in length and situated behind the wind pipe, which is protected against the entrance of food by a covering or lid called the epiglottis, which closes when the food is being swallowed.

Our food does not drop into our stomachs suddenly. It is carried down the gullet by a series of what are called

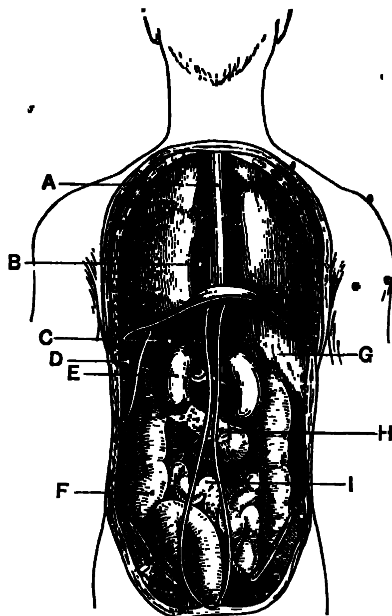


FIG. 17.—THE ORGANS OF THE CHEST AND ABDOMEN SEPARATED BY THE DIAPHRAGM, SEEN FROM THE BACK.

A, tube, where the food passes through (œsophagus); B, heart; C, stomach; D, the spleen, E, kidneys, F, main intestine; G, liver; H, pancreas; I, small intestine.

vermicular or worm-like movements. It is by this action that water and food can be swallowed by persons while standing on their heads, and that horses and cows can swallow while grazing.

The Stomach is merely a bag, which is larger at the one end than the other. The entrance to the stomach is known as the cardiac and the outlet as the pyloric orifice or opening. It is about 12 inches long. The gullet enters

near the middle. The interior of the stomach is lined with minute glands, called peptic glands, which secrete a liquid called the gastric juice. The gastric juice, amongst other ingredients, contains hydrochloric acid and substances called pepsin and rennin, both of which are ferments. It is chiefly by means of these substances that digestion is carried out in the stomach. About 240 ounces of gastric juice are secreted daily. The food is mixed with the gastric juice by the movements of the stomach walls,

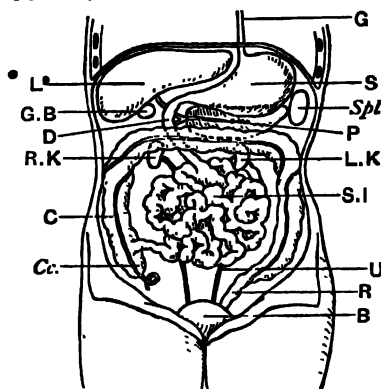


FIG. 18. DIAGRAM OF ORGANS IN ABDOMEN.

G, gullet; S, stomach; D, duodenum with bile and pancreatic ducts opening on inner side; S I, small intestines; *Cc*, caecum with vermiform appendix; C, colon or large intestine, R, rectum; L, liver, G.B, gall-bladder, P, pancreas; *Spl*, spleen, R.K and L.K, right and left kidneys; B, bladder with two ureters opening into it at the upper end.

caused by the action of certain layers of muscles in the same way as the food is mixed with saliva in the mouth by the movements of the tongue. Gastric juice digests nitrogenous food, but stops the digestion of starch. When food is digested in the stomach it is converted into a substance called chyme, which has a sour smell and taste. During digestion in the stomach the nitrogenous food stuffs are converted into bodies called peptones. These peptones and

salt, sugar, and other substances are partly absorbed in the stomach and partly in the intestines.

The Intestines are divided into the small and large intestine respectively. The small intestine comes first, and

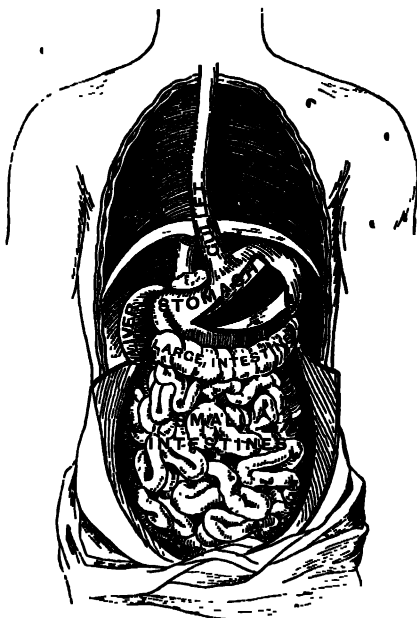


FIG. 10.

is about 20 feet, while the large intestine is only 5 feet in length. The first portion of the small intestine is called the duodenum, which is only about 10 inches long.

The duodenum has numerous small glands in its walls, which secrete a fluid resembling saliva. This fluid helps to digest the starchy food which escapes the action of the saliva in the mouth and stomach. The duodenum is an important structure also, from the fact that it is into

this part of the small intestine that the bile which is formed in the liver and the pancreatic fluid, which is formed in an organ called the pancreas, both enter. The pancreas, it may be here stated, is an organ 7 inches long and 1½ inch wide. When the chyme passes out of the stomach into the duodenum it becomes mixed with the pancreatic fluid and bile. The former helps to complete the digestion of starchy food.

The Pancreatic Fluid, besides acting on starchy and nitrogenous food, contains a substance which mixes with fats and oils in food, making an emulsion which is easily absorbed. Bile, as will be pointed out presently, has a similar action. Trypsin is the name given to the ferment in the pancreatic fluid, which converts nitrogenous food into peptones.

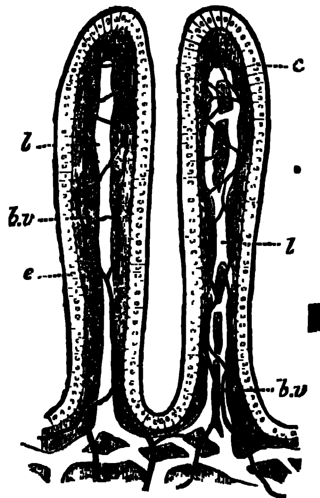


FIG. 20.—TWO VILLI. HIGHLY MAGNIFIED.
e, epithelium blood-vessels; l, lacteals.

The small intestines have numerous small structures called villi, containing blood-vessels and lacteals, which absorb the digested food, and also numerous small glands, which secrete a fluid called the intestinal juice. The fluid in the lacteals is called chyle, which has a milky appearance, hence the term lacteals. The walls of the small intestine themselves have also a large supply of lacteals and blood-vessels.

The Liver is situated on the right side of the body behind the lower ribs and below the diaphragm or midriff.

It extends in health to about half an inch below the ribs, and can be felt during inspiration. A healthy liver weighs from 40 to 60 ounces. It sometimes, however, becomes greatly enlarged and heavier from disease. The liver is made up of cells each about the $\frac{1}{500}$th part of an inch in size. The small cells secrete bile from the blood carried in the blood-vessels which pass through it. The amount of bile secreted daily is about 40 ounces. When made the bile is conveyed in numerous small tubes, called bile ducts, into a single larger duct which, as has been stated, pours its contents into the duodenum. If there is any obstruction in this large duct the bile which should pass into the duodenum gets absorbed by the blood-vessels, is carried in the circulation to all parts of the body, and gives rise to what is called jaundice. Bile emulsifies fat, prevents food from decomposing and forming gas, and helps the digested food to pass easily along the alimentary canal. It is afterwards partly absorbed by the intestine, gets into the blood, and helps to keep up the heat of the body. A substance called glycogen or animal starch is formed in the liver in large amount. Glycogen becomes converted into sugar. Sometimes the sugar formed in this way is so great in amount that it cannot all be made use of, and the excess quantity passes out of the system in the urine. The disease called diabetes is due to this cause.

The large intestine absorbs whatever fluid remains after digestion, collects its waste products, and ultimately passes them out of the system.

THE BLOOD AND ITS CIRCULATION.

We all know that the blood which escapes from a cut artery is of a bright red, and that from a cut vein of a dark purplish colour. When a drop of blood is placed

under a microscope it is found to consist of innumerable yellowish-looking small flat bodies called blood corpuscles, which float about in a colourless liquid called the liquor sanguinis (blood liquid). There are two kinds of blood corpuscles, viz., the red and the white.

Red Blood Corpuscles are only about the $\frac{1}{3200}$th part of an inch in diameter and the $\frac{1}{12000}$th part of an inch in thickness, so that in one drop of blood we may have

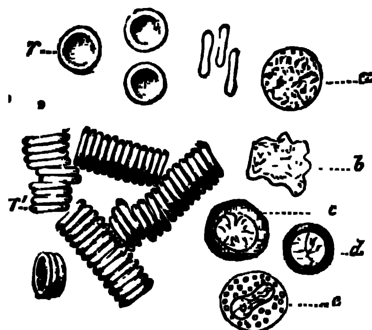


FIG. 21.—BLOOD CORPUSCLES.

r, red corpuscles seen on the flat; *r'*, red corpuscles seen on edge, and run together into rows; *a*, *b*, colourless corpuscles, nucleus not seen; *c*, *d*, *e*, colourless corpuscles, nucleus seen; *e*, containing also granules.

several millions of them. When observed under the microscope they are seen to run together in the form of rolls of coins. These corpuscles vary in size, shape, and structure in different animals. It will be remembered that, when dealing with respiration, it was pointed out that these little corpuscles take up oxygen, which they convey to all parts of the body. This is their chief use. The blood also contains the elements of nutrition for the tissues of the body. It carries away the waste products to the different organs which excrete them. It is from the blood, moreover, that the saliva, gastric, and other juices are formed. It also helps to keep the body warm.

White Blood Corpuscles. We always find in blood some small white bodies, called white blood corpuscles. In healthy blood there is usually one or two to about every five or six hundred red corpuscles. In some diseases the number of white corpuscles may be very great. White blood corpuscles are globular in shape and larger than the red, or about the $\frac{1}{2500}$th part of an inch in diameter. In the living state they are always changing their form. Each of the white or colourless corpuscles has in its centre what is termed a nucleus. The nucleus can be brought into view when a little water or dilute acetic acid is added to blood when it is being examined under the microscope. Certain colouring matters do the same thing. There is a nucleus in the white blood corpuscles of all animals. The red blood corpuscles of human beings and animals which suckle their young have no nuclei. The red corpuscles of birds, fishes, and some other animals have, however, large nuclei.

Coagulation of the Blood. In clotted blood the red solid portion consists chiefly of the red blood corpuscles caught in a net-work of a substance called fibrin. The liquid portion is called serum. This is the same substance as that which escapes from a blister of the skin when it is opened. Blood always clots when it comes in contact with any outside object, and it is the fibrin chiefly which causes this. If this did not happen we might bleed to death from even small wounds. The blood serum contains a large quantity of albumen. It also contains soda and potash and other mineral substances obtained from the food which we eat. Soda is one of the chief constituents of blood serum, and is got chiefly from the common salt which we use. These mineral substances, called alkalies, keep the fat, which is liquefied in the alimentary system, in the same liquid state in the blood, and thus makes it more fit for the nourishment of our bodies. All the other

solid mineral matter which we consume, such as lime and iron salts, are similarly dissolved to be made fit for nature's use. Blood also contains gases, such as carbonic acid gas, nitrogen, and oxygen. One volume of blood contains about ½ volume

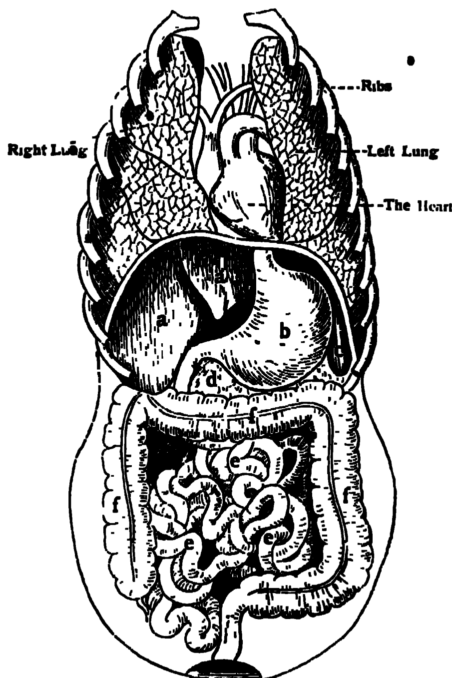


FIG. 22.—SHOWING THE POSITION OF THE APEX OF THE HEART.

of these gases. The blood weighs over one-thirteenth part of the entire weight of the body, while the gases in solution represent in their free state about one half of the entire volume of the blood, of which about ⅔ are carbonic acid, and about ⅓ oxygen. There is also a little nitrogen.

The Circulation. The circulatory system consists of the heart, arteries, capillaries, and veins.

The Heart is a muscular organ containing four cavities, which are separated from each other by partitions. The two upper cavities are called the right and left auricles, and the two lower the right and left ventricles respectively. The right auricle opens into the right ventricle, and the left auricle into the left ventricle. Each of these openings is provided with little valves or doors, which open and shut alternately. It is situated within the chest cavity (Fig. 22) and is inclined more to the left than the right side. The pointed end of the heart, called the apex, may be felt beating a little below the left nipple between the fifth and sixth ribs. The sounds produced when the heart beats may also be heard if the ear is applied to this part of the chest wall.

Arteries are the tubes through which the pure blood from the heart is distributed to the different parts of the body. They are of an elastic nature, so that when the blood passes into them they yield, become distended, and afterwards contract, and thus force the blood onwards. It is this action which causes the pulsation at the wrist and elsewhere. The heart beats from 70 to 90 times per minute in healthy adults, but much more quickly in children. The number varies also in disease, and under numerous other conditions, such as during rest, exercise, and sleep.

Capillaries are the smaller tubes in which arteries end. They are of microscopic size, and are so numerous that we cannot puncture any portion of our skin without causing blood to ooze from them. Arteries have three different layers or coats. Capillaries have only one coat, which is exceedingly thin, and consists of small delicate cells, through which the elements of nutrition contained in the blood pass to the tissues. At the same time waste matters are thrown out of the tissues and pass into the blood, which passes on to the veins, which begin where the capillaries end.

Veins are tubes which convey the impure blood back to the heart and thence to the lungs, where it is purified as



FIG. 23. A VEIN SLIT OPEN, SHOWING VALVES.

described under respiration. The veins are provided with small valves (Fig. 23) at intervals, so that the blood which has passed on may not be allowed to return during its journey to the heart.

The Main Artery of the body is called the aorta. It begins at the left ventricle, passes up a little way behind

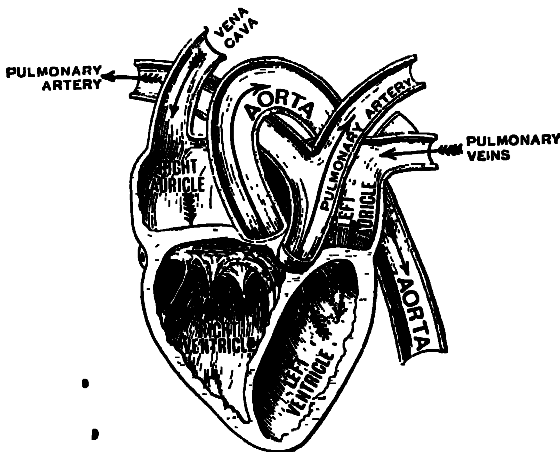


FIG. 24.—THE HEART.

the breast-bone, then makes a curve and passes downwards alongside the back-bone, dividing lower down into two

branches, which again subdivide into two branches, one of which passes down either leg. The latter give off still smaller branches to supply nutrition to the muscles and other tissues. The aorta also gives off branches to supply the head, neck, and arms. The large veins which receive impure blood from the small veins of the upper and lower

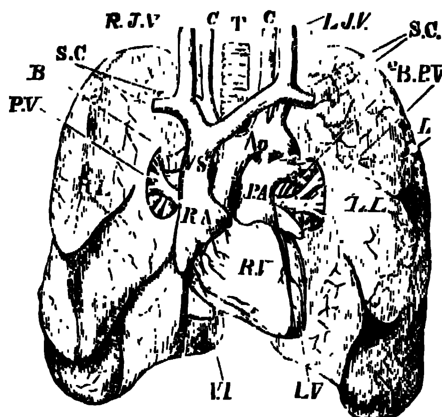


FIG. 25.—FRONT VIEW OF THE HEART, GREAT VESSELS, AND LUNGS. (The lungs have been drawn aside in order to show the other structures fully. The outer layers of the pericardium and the pleuræ have been removed.)

R.V, right ventricle; *L.V*, left ventricle; *R.A*, right auricle; *L.A*, left [illegible]le; *Ao*, aorta; *P.A*, pulmonary artery; *P.V*, pulmonary veins; *R.L*, right lung; *L.L*, left lung; *V.S*, vena cava superior; *S.C*, subclavian [illegible]els [illegible], carotids; *R.J.V*, and *L.J.V*, right and left jugular veins; *V.I*, [illegible] cava inferior; *T*, trachea; *B*, bronchi.

All the great vessels [illegible]ut those of the lungs are cut.

portions of the body empty themselves into the right auricle through large veins called the venæ cavæ. The impure blood passes from the right auricle into the right ventricle, and the right ventricle in its turn pumps it through the pulmonary artery on to the lungs to be purified. When purified it comes back to the left auricle through the pulmonary veins. The left auricle sends the purified blood into the left ventricle, and the left ventricle in its turn

sends it into the aorta to be distributed as already described. (Figs. 24, 25.) Small valves are placed at the different openings of the heart to make sure that the blood goes the right road and to prevent it from rushing back to where it came from. The blood is sent from the auricles into the ventricles by a contraction of the auricles in the upper half of the heart. It is forced into the aorta and the lungs from the ventricles by a similar contraction of the ventricles.

AIR.

The Composition of Air. Pure air consists of two gases, namely, nitrogen and oxygen, which are mechanically mixed; that is to say, do not combine chemically to form a third body as hydrogen and oxygen do to form water. Air is seldom pure. In every 100 parts of what may be for all practical purpose regarded as pure air there are of

Oxygen,	20·99 parts.
Nitrogen,	78·97 ,,
Carbonic Acid,	·04 ,,
Watery Vapour,	Traces.
Ammonia,	,,
Ozone,	,,

Ozone is an active form of oxygen.

The Physical Characters of Air. Air cannot be seen in its gaseous form. It can, however, be liquefied by great cold or pressure, which brings the small particles of which it is composed more closely together. On the other hand, air expands, increases in bulk, and becomes lighter when heated. Pure air has no smell.

The Need of Air. Fires and lights go out when the air supply is cut off. On the other hand, fires burn more briskly when a liberal supply of air is provided by blowing into them with a pair of bellows or through a piece of hollow

bamboo, or other tube, or using a punkah or fan. These effects are due entirely to the oxygen contained in the air. Just as combustion is impossible without air, so human beings and animals could not live without it. The oxygen, of the air we breathe, purifies our blood, enables us to make use of the food we eat, and fits it for the support and growth of our bodies. It also produces heat, and thus helps to keep our bodies warm. Combustible substances burn with great rapidity in pure oxygen. In the same way, if we breathed pure oxygen, our tissues would be rapidly consumed. In fact it would be impossible to live. The oxygen of the air is therefore mixed with nitrogen gas, which dilutes it and renders it fit for breathing.

The Kind of Air required. Air must be as pure and fresh as possible. The purest air is to be found in the neighbourhood of the sea, on the tops of mountains, and in country districts. Ozone is found in larger quantity near the sea than elsewhere. The most impure air is to be found in large cities and towns where there is much trade, and where manufactures are carried on to a large extent, and in all places where the removal of dirt is neglected.

IMPURITIES OF EXPIRED AIR.

Carbonic Acid. The expired air is estimated to contain about 100 to 120 times more carbonic acid than the inspired air. The amount of carbonic acid given off is about three-fifths of a cubic foot every hour. The amount, however, depends very much upon age, sex, and whether a person is working hard, taking exercise, or resting. The impure blood in the lungs is dark in colour, like the blood which escapes when a vein is cut. After absorbing oxygen it becomes bright red in colour, like the blood which spouts out in jets when an artery is cut. If the blood which flows

from a vein is collected it can be purified by passing oxygen through it. Bright coloured pure blood from arteries can, on the other hand, if collected, be made dark and impure by passing carbonic acid gas through it. The presence of carbonic acid in expired air can be shown in the following manner.

Breathe into a clean bottle, made of clear glass. Pour some fresh lime water into the bottle, and shake it well. The lime water will turn milky white owing to the carbonic acid combining with it. A chalky compound (calcium carbonate or carbonate of lime) is formed.

A light is speedily extinguished when put into carbonic acid gas, and it is due to the accumulation of this gas and loss of oxygen that a burning candle gradually goes out when put into a glass jar from which air is excluded by covering it up with a lid. Expired air is estimated to contain about 16·033 volumes of oxygen, 79·557 of nitrogen, and 4·380 of carbonic acid gas in one hundred volumes.

Watery Vapour. About 25 to 40 ounces of watery vapour escape from the lungs daily. The expired air is saturated with it, that is to say it could not hold more. Its presence can be demonstrated by breathing on a cold piece of glass or other substance. In cold countries it becomes condensed, and may be seen escaping from the mouth like steam, and it may also be seen running down the glass windows of occupied railway carriages, or dwelling rooms, theatres, and similar places, the windows of which are kept shut to keep out the cold.

Organic Matter. The organic matter in the expired air consists of infinitesimally small particles of dead tissue and the foul gases of their decomposition. This is the most injurious impurity of expired air. It is contained in large amount in the watery vapour, which, if collected and kept in a bottle, rapidly decomposes and gives off a most offensive

odour. Other impurities, such as ammonia, a substance called urea and mineral matter, are also found in small quantities in expired air.

The peculiar sickly odour of overcrowded and badly ventilated rooms most noticeable on entering such places from the fresh air outside is due not so much to the large amount of carbonic acid present as to the foul organic matter. This foul matter, although obtained, in large part, from the lungs, is also given off from dirty skins, dirty feet, dirty mouths, decayed and dirty teeth, and dirty clothing. The amount of organic matter, from these sources, present in the air, increases in proportion to the increase in the amount of carbonic acid gas. It is, for this reason, found convenient to judge of the extent of the pollution of the air of a room by estimating the amount of carbonic acid gas present, which is more easily done. The carbonic acid should never exceed 6 parts in 10,000 or ·6 or three-fifths of a part in 1000 parts of air.

IMPURITIES IN THE AIR OF INHABITED PLACES.

These consist of the impure matter given off by the lungs, skin, and other organs of the body. Fires, gas jets, oil lamps, and candles during combustion, like the lungs, use up the oxygen of the air and give off carbonic acid gas, watery vapour, particles of carbon, and other waste products. It has been estimated that two hard sperm candles, or one oil lamp, consume as much oxygen and give out as much carbonic acid as one man. It has also been estimated that one batswing gas burner consumes as much oxygen and gives out as much carbonic acid as at least two men.

Carbonic acid and other foul and injurious gases are also given off in large quantities from decaying waste matter in

dirty streets, drains, sewers, cesspools, latrines, stables, cattlesheds, over-crowded, badly selected, and ill-regulated graveyards, brickfields, marshes, manufactories, and other similar places. The air may also contain portions of human hair, skin, fibres of dirty rags, the eggs of insects, and even the insects themselves. No less than 200 different kinds of living creatures are said to have been found in the air. The air of inhabited places may also be rendered impure by the presence of dust which may be teeming with germs of disease.

Diseases Caused by Impure Air. Headache, faintness, sickness, vomiting, and diarrhœa are often caused by the foul air of rooms, public halls, theatres, and other over-crowded and badly ventilated buildings. People who constantly live under such conditions suffer from loss of appetite, sleeplessness, low spirits, and general bad health. The health of children more especially is liable to suffer from the effect of bad air. Bad air is often also the predisposing condition of diseases of the lungs, such as bronchitis and consumption, and of small-pox, measles, diphtheria, dysentery, plague, diseases of the skin and eyes, and numerous other diseases. It is said that the death rate from lung diseases is 3 or 4 times greater among working people from the dust caused by the nature of their employment than amongst other people.

A great deal of the enteric fever and dysentery which occurred amongst the British soldiers during the South African war is said to have been caused by dust getting into the milk and water after they had been boiled. It is a well-known fact, too, that far more sickness prevails and more deaths occur in dirty cities, towns, villages, and houses than in places which are kept clean, and where the air is always fresh and pure.

How to Keep the Air Pure. Every attention should

be paid to the careful construction and cleanliness of houses, drains, latrines, etc. Refuse of all kind should be immediately removed and carefully disposed of. There should be a liberal supply of water for cleansing purposes. We should keep our houses, our bodies, and our clothes clean. An outlet should be made for the smoke in cookhouses. Cooking should not be done in sleeping rooms. Animals such as cows, buffaloes, goats, cats, and dogs should not be allowed to live in or near rooms occupied by human beings. Attention to matters of this kind will help very considerably to keep the air pure.

HOW IMPURE AIR MAY BE PURIFIED.

Ventilation. Amongst the means whereby impure air may be purified ventilation is the most important. Ventilation means the removal or dilution of the impurities of the air of inhabited rooms and buildings with fresh air from the outside admitted through the windows, doors, or other openings. It is facilitated by the natural tendency of gases to mix with each other, by wind and by heat. The following are some of the ways in which ventilation is effected.

By Diffusion. Just as smoke from a chimney or a pipe mixes with the air and gradually disappears, or as coal gas mixes with the air in rooms, so does the impure air of rooms tend to escape and mix with the fresh outside air. The fresh outside air similarly tends to enter the room and mix with the impure air. This is known as the "diffusion of gases." Fire-places in cold countries help diffusion considerably. The heated impure air is drawn in the direction of the fire-place, rushes up the chimney, and its place is taken by the cold pure air from the outside. Gas flames, enclosed in glass globes, open at the bottom, and placed near openings communicating with the outside air, are

sometimes used for ventilating purposes. They create a draught in the same way as fires do, and thus get rid of some of the impurities of the air. It is not desirable during cold weather or in cold climates, that one large opening only should be used for ventilation purposes. This method of ventilating may cause cold draughts and give rise to chills. Several small openings are better. This not only avoids draughts, but the impurities of the air in every part of the room are thus more easily got rid of altogether or more evenly diluted. European houses, on account of the colder climate, are constructed in an entirely different way from houses in India, and the system of ventilation also differs very much. Valves in the walls near the ceiling are sometimes used for ventilating houses in European countries. They act very much like the *jhilmils* of the doors and windows of houses in India, which not only keep out the glare of the sun, and the rain, but help to keep the room cool, and allow the free entrance of air.

Ventilating tubes are also used in European houses. The air is admitted through an opening in the wall near the floor, and carried up the inside of the wall to a height of 6 or 8 feet. The placing high up in the wall of bricks with conical passages through them is another method which is sometimes employed. The hot impure air being lighter than cold air rises and is allowed to escape by other openings placed near the ceiling.

Figs. 26 and 27 show clearly some of the methods of ventilation just described. In cold countries the combined area of all the ventilating apertures should be about 24 square inches for each person. In the plains of India much more may be allowed without any risk of cold being caught from draughts. In fact sleeping rooms have in many instances as much door and window space as walls, and for many months in the year are kept open all night

long in order to encourage free movement of the air. Punkahs and electric fans are used during the hot weather for the purpose of keeping the air in motion, and thereby cause an indraught of air from the outside. The impurities of the air are also thus got rid of to some extent. The air of rooms at such times of the year is cooler than the air outside. The outside hot air does not tend, however, to rush into the rooms and mix with the cold air, as cold air

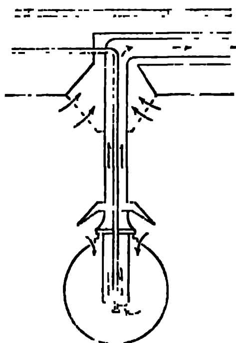


FIG. 26. VENTILATION BY GLOBE, GAS LIGHT AND AIR SHAFT.

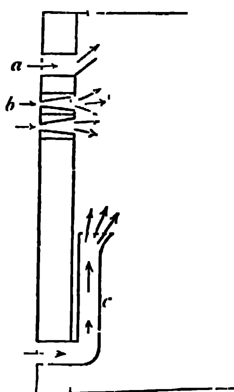


FIG. 27.—a, Sheringham valve; b, Ellison's bricks; c, Tobin's tube.

tends to rush into a hot room and mix with the hot air in it. This has been explained before. It is for this reason that the ventilating space of Indian houses needs to be so great, that rooms have to be so large and ceilings so high. In the huts of the poor and ignorant natives of India there is, as a rule, no outlet of any kind for the air, which is vitiated by the smoke from fires, in addition to human and animal impurities, except through small cracks in the walls, chinks in doors, through the thatch, or between the tiles of roofs. The houses of the well-to-do are, as a rule, provided

with sufficient means for permitting foul air to escape. Unfortunately, however, they are often not made use of. It is most necessary that provision should be made for the ventilation of staircases into which foul air from all the adjoining rooms finds its way. An opening made in the roof will serve this purpose, but arrangements must be made to keep out the rain. No house, the staircase of which is not properly ventilated, can be healthy. Well ventilated staircases help to remove the impurities of the air of adjoining rooms.

Fans driven by steam, or otherwise, are often used for ventilating the between decks of passenger ships, engine rooms, large public schools, mills, and other similar buildings. They do so either by supplying fresh air or by forcibly withdrawing the impurities in the air. Most good is effected by the latter method. The former causes strong draughts, and all the foul air is not purified.

Central air shafts in which fires are kept burning to create an upward draught are also sometimes used for ventilating purposes. Coal mines are ventilated in this way. Compressed air has also been used.

Wind. Wind helps considerably in the ventilation of buildings by forcibly removing the impurities of the air.

Rain. The purity and freshness of the air after a heavy and continuous shower of rain are due to the fact that the dust and other impurities have been washed out of it into the soil or water channels.

Green Plants. Green plants under the influence of the sun's rays split up carbonic acid into two elements, carbon and oxygen. They use the carbon for their nutrition and growth, and set the oxygen free. They are, therefore, also useful as purifying agents.

Amount of Fresh Air needed for Ventilating Purposes. The cubic capacity of a room is calculated by

multiplying the length, breadth, and height together. Each person should, if possible, have a cubic space measuring 1000 feet. A room 10 feet long, 10 feet wide, and 10 feet high would give this amount of cubic space. The air in such a room should be changed three times hourly. In other words, 3000 cubic feet of air must be supplied hourly to prevent the carbonic acid gas and other impurities accumulating to a dangerous extent. In calculating the cubic capacity of a room, the space occupied by furniture should be deducted. A room which affords less than 300 cubic feet of space to each individual is overcrowded. Some few years ago the writer inspected and submitted a report on a room in Calcutta, the cubic capacity of which was 540 feet. This room was occupied by 8 persons, affording each person only 70 cubic feet of space. There is a case on record, however, where a room in Leicester, in England, contained 6 persons with only 51 cubic feet of air space each, and with three gas-lights burning (Reynolds).

The superficial area, or the floor space, allowed to each person should not be less, if possible, than 80 or 90 square feet. This is calculated by length and breadth measurements. Much greater cubic space and floor area are required in hospitals. Where it is not possible to give so much, as, for example, in schoolrooms, mosques, temples, churches, theatres, buildings for public meetings, and all places in which unhealthy occupations are carried on, but which are not continuously occupied, such as printing presses, shops, godowns, and mills, the very best means of ventilation should be provided. The best test of the impurity of air is smell. The amount of fresh air admitted into a room or building should always be sufficient to prevent the smallest trace of smell being perceptible on entering them from the fresh air outside.

Concluding Remarks on Ventilation. Doors, windows, and other openings should be kept open as much as possible day and night. Fresh air is especially needed during sickness. The practice of shutting up doors and windows during sickness in Indian families is very common and exceedingly dangerous. The evil is often increased by the smoke arising from burning logs of wood and lamps, for which, as has been already stated, there is no escape, and by the foul matter from the lungs and bodies of the large number of relatives and friends attending the sick.

WATER.

The Composition of Water. Water is composed of two gases, namely hydrogen and oxygen. These two gases are not mechanically mixed in forming water as are the nitrogen and oxygen of which air is composed. They combine chemically to form water in the same way as carbonic acid combines with the lime in lime water to form a chalky compound which is neither the one nor the other, but a new and solid substance composed of both. Water is for this reason known as a chemical compound. When made slightly acid, water can be split up into hydrogen and oxygen by the use of electricity; and, on the other hand, the two gases may be made to combine to form water.

Water may exist in the form of either a gas, a liquid, or a solid. Steam, mist, clouds, dew, rain, snow, hailstones, and ice are all forms of water.

The Use of Water. Water is required for the sustenance and growth of all animals and plants. Without water life could not exist. Three-fourths of the weight of our bodies consist of water, part of which is got from the

food we eat. Some vegetables, such as turnips and potatoes, consist almost entirely of water. The greater portion, however, is taken into our systems in drinking water, tea, and other liquids.

Effects of the Scarcity of Water. Without water the crops would wither and die, food would become scarce and dear, and famine, sickness, and death would ensue. Wells and tanks are sometimes the only source of water supply for the crops when the rains fail. The water drawn from these sources is allowed to flow into the fields or gardens through shallow surface drains or channels, and in this way the crops are kept alive. This operation is called irrigation, and may be seen on a small scale in almost any Indian village at certain seasons of the year. Irrigation on a much more extensive scale, however, is carried on by the Government in those parts of the country in which the rainfall is scanty or where the rains often fail altogether. Many thousands of miles of canals have been made for this purpose. In the year 1898 no less than 46,000,000 acres, or nearly 72,000 square miles of land, which would otherwise have remained dry and barren jungle, were by means of irrigation with water obtained from tanks, wells, and canals, yielding rich harvests of grain and other produce for human use. Moreover, 4,000,000 more acres, chiefly in the Punjab and Sindh, were at that time about to be brought under cultivation in the same way. It will thus be seen that water is of the greatest value to the growth of the crops. Water is of no less value, however, for the growth and health of our bodies. Without it our kidneys and other organs could not perform their natural functions; our skin would cease to act, and become dirty and diseased. We should be unable to wash our clothes, keep our houses clean, or cook our food. Drains would become stagnant and the

air would be poisoned with foul gases. Sickness would break out, and we should all soon die.

Quantity of Water required. In European houses between 20 and 25 gallons of water are required daily per individual for drinking, cooking, washing cooking utensils, washing clothes, bathing, and other household purposes. Besides this, in large commercial towns, a supply is needed for carrying on trade, for keeping sewers and drains clean, for watering streets, and other purposes. About 30 gallons are considered sufficient for all purposes. In towns in India a smaller supply has been found sufficient.

SOURCES OF WATER SUPPLY.

Springs. Water is sometimes obtained from great depths in the ground through springs. Hollow tubes are sometimes sunk in the ground to great depths in

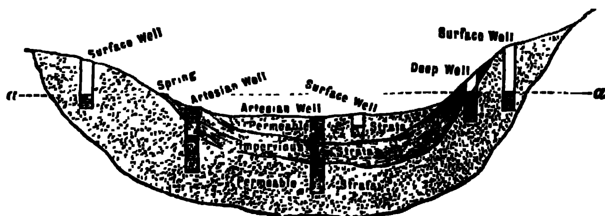


FIG 28.—SOURCES OF WATER SUPPLY.

order to obtain a supply of water, the water in such cases being raised by pumping. These are known as tube-wells. Water obtained from this source is the best and safest for drinking purposes. Springs and tube-wells should, however, be carefully protected against pollution.

Deep Wells. Wells over 50 feet in depth are sometimes, though not quite correctly, described as deep wells. It is more correct to regard as deep wells only such wells

as are sunk through the surface soil and through an underlying impervious stratum into a deeper water-bearing one (Willoughby). Deep wells in some cases do not exceed 20 feet in depth. Water from this source is, as a rule, also good and safe to use.

Artesian Wells (Fig. 28), are made by boring, and extend to a great depth at times through various impermeable strata before water is reached. The water sometimes escapes from them like the water from a fountain, owing to the great pressure to which it is subjected.

Surface Wells. Wells which are less than 50 feet in depth, and are not of the character above described, are sometimes called surface wells. Surface wells are sometimes mere hollows in the ground. They obtain their water supply from the surface soil, and are therefore very easily polluted by dirty water and other filthy liquids, and should not be used. These wells may be comparatively deep, and yet be surface wells in the true sense of the term.

Tanks. The water of tanks is often used for drinking and other domestic purposes. Unless specially set apart for human use and carefully watched, which is not easy, water from tanks is exceedingly unsafe to use, because they are as a rule very badly polluted owing to the dirty habits of the people who use them and by animals.

Hills and Lakes. Water from hills and lakes situated far away from human dwellings, in places where the land is not cultivated or used for grazing cattle, and where there is little or no decaying animal or vegetable refuse, is good and wholesome. Many large towns obtain their water supply from such sources. Bombay and Madras, for example, obtain their water supply from distant hills. Loch Katrine, a lake situated at a distance of over 30 miles

from Glasgow, a town as large in size and almost as large in population as Calcutta, is the principal source of the water supply of that great city.

Rain Water. Rain water collected and stored in large cisterns underground is sometimes the only source of the water supply. In large manufacturing and dirty towns rain water is rendered unsafe for use by the gases and other impurities contained in the air. In country districts where the air is pure rain water may be safely used, and is much softer and better fitted for general use than water obtained from most other sources.

Sea Water. It now and again happens that the supply of drinking water, carried in the large iron tanks with which all steamers and ships are fitted, is exhausted before the place of destination is reached. In those circumstances the crew and passengers have to fall back upon the use of sea water which is freed from its salt and other impurities, which make it unfit for use, by boiling it in specially constructed boilers and collecting the steam in separate chambers or condensers, where it forms water on cooling. This process is known as "distillation," and the water thus obtained is called "distilled water."

Rivers. Many large cities obtain their entire water supply from rivers. London, for example, is supplied chiefly from the River Thames and Calcutta from the Hughli river. Many lakhs of rupees are spent yearly in the collection and purification of water obtained from this source. The water before use is purified by passing it through filtering beds made of stone, bricks, or other material of different sizes, and sand of coarse and fine quality, which must be thoroughly cleaned before being used. After being thus purified it is conveyed in large underground pipes or mains and distributed throughout the city by means of smaller branch pipes made of galvanised

or wrought iron or lead. These pipes should be so carefully constructed that foul gases or liquids and other impure matter may not be able to find their way into the water supply through cracks and other defects Severe outbreaks of disease have often been caused in this way. Water sometimes acts on lead and dissolves it One-sixtieth part of a grain of lead in a gallon of water will cause colicky pains in the belly and other symptoms of lead poisoning.

The water thus purified is often conveyed into the houses of those who can afford to pay for it. The poor have it at their doors, and a liberal supply can be drawn from the stand pipes by merely turning a tap or handle, or in some cases by pressing a knob. Dirty tanks and wells are no longer required in such cities, and the few that are not filled up are now-a-days used chiefly for supplying water for washing floors and as a precaution against fire. People who use properly filtered water only live cleaner and healthier lives than those who, either of their own choice or because there is no other supply available, continue to use the water of tanks and wells. Since the introduction of the filtered water supply into Calcutta the deaths from cholera and other water-borne diseases have been very considerably reduced in number. The same freedom from such diseases is enjoyed in other towns with a good supply of filtered water.

HOW WATER IS POLLUTED.

Pollution of Wells. The well may be a shallow one. It may be dug in a loose and porous or soft and sandy soil through which impure liquids easily percolate. Either there may be no masonry walls, or the walls, if any exist, may be broken and out of repair generally. The mouth of the well may be below the level of the surface of the ground.

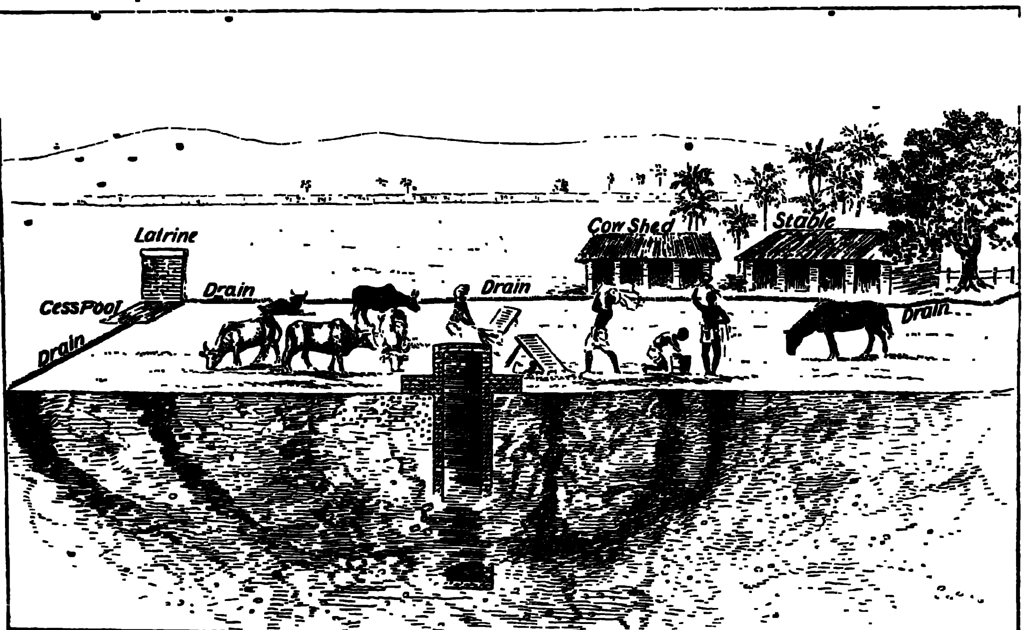


Fig. 29.—Showing how the Water in Wells is sometimes Polluted in India.

It may be situated near a dirty drain, or a badly constructed and unclean latrine, cesspool, stable, or cattleshed. Buffaloes, cows, and other animals may be tied up too close to it. The washings of the street, latrines, and foul contents of drains, and the discharges of animals can thus easily find their way into wells such as those which have been described above. There are other ways, however, in which wells are often polluted. If the well is not covered, straw, leaves, and dust may be blown into it. The water may be defiled by birds, which often build their nests in wells. It is a common practice in India, too, for people to wash their dirty clothes and bathe themselves while standing over wells, and dirty vessels and dirty ropes are often used for the purpose of drawing water. Moreover, it often happens that wells are not cleaned out for years at a time. Mud, broken pots, pieces of rope, and other refuse in consequence collect at the botton, and sooner or later stop the spring from which the water flows. No fresh water can get into the well, and that which it already contains soon becomes unfit for use. These, then, are some of the ways, all of which the writer has seen, in which the water supply of wells may be polluted and rendered unsafe for human use.

Pollution of Tanks. Tanks are, as a rule, more polluted than wells. Ignorant and dirty people often build their latrines near them, or the margins of the tanks may be used instead of latrines, with obvious results when a shower of rain falls. The liquid refuse from latrines, cattlesheds, and similar places, and the foul contents of drains are often allowed to flow into tanks. Dhobies not unfrequently ply their trade in them, and they are in many cases resorted to by thousands of people daily for bathing purposes. Further, beggars and others with all kinds of loathsome diseases are often to be seen using the water of

tanks for washing their sores and the rags with which they are dressed.

Pollution of Rivers. Besides being polluted in the same way as tanks, rivers are still further defiled by the highly objectionable and dangerous custom of throwing the bodies or the ashes of dead persons and the carcases of animals into them. The liquid refuse of factories and mills is often disposed of by allowing it to run into rivers, while the whole of the sewage of large towns is often got rid of in this way. Rivers are also polluted by refuse being thrown into them from steamers and ships, and by the dirty and careless habits of boatmen. The night soil of villages is often collected and thrown into rivers. The result of all this sinning against the laws of health is the frequent outbreak of epidemic diseases of the most virulent kind.

Impurities in Water (Fig. 30). When water is allowed to stand in a glass tube particles of sand, mud, or other solid bodies which it may contain will sink to the bottom. The eye may be able to tell what these particles are. The most dangerous impurities in water, however, such as the germs of cholera and other diseases, are so very small that they can be seen only under certain conditions and often with great difficulty, with the help of a very powerful magnifying instrument called a microscope. The eggs of worms and the young of mosquitoes may also be found in water, and these may give rise to disease in people who drink it. Worms are often caused in this way. Malarial fever, which causes so many deaths yearly, may possibly be due in many cases to the use of water containing the parasites which cause that disease. Recent discoveries, however, show that the bites of mosquitoes of a certain kind (anopheles) are the most common cause of malarial fever. Elephantiasis, a disease in which the legs, arms, and other parts of the body become enormously enlarged, and which is so common in

many parts of India, for example, Orissa, is another disease which it is supposed may be caused by water rendered impure by mosquitoes. Recent investigations have shown



Fig. 30.—Micro View of Some Drops of Water taken from a London Cistern.

that this disease may also be caused directly by the bites of those insects. Cholera, dysentery, diarrhœa, and enteric fever are other well-known diseases which may be caused by impurities in water.

A few Special Observations on the Impurity of Water. If on placing a drop of water from a well under a microscope fragments of cotton or portions of the human body are found, the only conclusion to be drawn is that the well is being polluted by household impurities, the water is unfit for use, and that the well should be abandoned at once. When many people or several members of a family, living in the same village, street, or house, are attacked with cholera at or about the same time, the well, tank, or other source of water supply is most like to be the cause of the outbreak. In such cases the water on inspection may be clear, taste well, appear to be pure and wholesome, and be well liked by those who drink it. It should be noted, however, that water of this kind may be very badly polluted with disease germs, and therefore most dangerous to health if used.

How we can tell when Water is Polluted. The best test is the health of those who drink it. If there is no sickness in the form of malarial fever, with enlarged spleens, cholera, and so forth, the water may be regarded as safe and fit for use. If, however, sickness breaks out the water supply should immediately receive attention. In large cities, such as Calcutta, the water is examined weekly to ascertain the degree of purity or impurity of the supply. Wherever possible this should be done, as prevention of disease is better than cure. The examination of water may be divided into three parts, namely: (1) Physical, (2) chemical, and (3) bacteriological.

Physical Examination of Water. In this examination the colour, clearness, sediment, smell, lustre, and taste have to be noted. Good water has always a bluish colour. Greyish water may be good also. Greenish waters are not necessarily bad. Yellow and brown waters are always unsafe to use. Water should be clear and free from

deposit. It may, however, as has been already stated, contain sand or other mineral matter, which gives it a yellow colour, and yet be perfectly safe. Good drinking water should be free from smell. Smell can be easily detected by heating the water and inhaling the steam that rises from it. Pure water should be neither bitter, sweet, salt, nor sour. It should be practically tasteless.

Chemical Examination of Water. This examination enables us to ascertain, amongst other things, the extent to which any given sample of water is polluted with organic matter of human, animal, and vegetable origin, and the degree of softness or hardness of water. A chemical examination can be made and the results understood only by persons who have acquired a thorough knowledge of chemistry after long and diligent study. The results of a chemical examination may show the water to be apparently of good quality, and yet it may contain the germs of the most fatal forms of epidemic disease, the presence of which can be detected only with the help of the microscope.

Bacteriological Examination of Water. The presence of fibres of cotton, wool, and such like objects can usually be easily detected, but can sometimes be brought into view only by the use of staining reagents. Mr. Hankin thus describes the method of counting the number of germs or microbes in water: "The method of counting them depends on the fact that microbes whose presence in water we have to deal with can only grow in meat jelly. A small quantity of water to be tested is added and mixed with some melted meat jelly. The jelly is allowed to cool. Twenty-four hours later the jelly, which previously had been perfectly transparent, will be seen to contain numerous white or yellow spots. The reason for this change is as follows: When the jelly became solid each microbe was fixed at one point or other in the jelly, presumably separate from its

neighbours. Each microbe began to grow and reproduce. Each parent microbe and the daughter microbes necessarily remain together, as they cannot move through the jelly. They thus form a small colony, which as time goes on becomes so large as to be visible to the naked eye. Generally these colonies are as large as small pinheads, and are as visible in the jelly as the small spots mentioned above. By counting the colonies we obviously arrive at the number of microbes present in the water added. If the bulk of this water is known, we can calculate how many microbes were present." This is called a bacteriological examination, and can be performed only by an expert in such matters.

How to Prevent the Pollution of Water. If wells are used they should be as deep as possible. The walls should be made of thick stone, bricks, or other similar hard material. The walls should be set in cement, and should extend two or three feet above the level of the ground, forming a parapet. There should be no cracks in the walls. When the walls begin to sink, or otherwise get out of order, they should be repaired at once. The ground round the well should be paved with stone slabs or bricks on edge, set in cement, and the pavement should have a slope, 3 or 4 feet in width, to allow the spill water to run off. A small drain should be constructed round this pavement to catch the spill water, which should run into a branch drain from the main drain surrounding the pavement, and thus be conveyed to a safe distance from the well. This will prevent it soaking into the ground and getting back into the well. The mouth of the well should be covered, leaving an opening large enough to admit a bucket. A small trap door with hinges should be provided with which to cover the opening after drawing water from the well. This will help to keep out birds, dust, leaves, straw, and other

impurities. An iron bucket with a chain running over a pulley should be attached to each well, and the use of this bucket only for drawing water should be insisted upon. This will prevent the use of dirty vessels and ropes. The use of pumps would be better still (Fig. 31). When it is possible to have repairs executed without great delay, if they get out of order, pumps are the very best means of keeping wells clean, and should be used in every town and village where there is no filtered water supply. Bathing and washing of clothes and cooking vessels near wells should be prohibited. Wells should be periodically cleaned out. Lastly, but not least, every town and village should be kept thoroughly clean. No kind of offensive matter should be allowed to remain either in the streets, around human dwellings, or elsewhere, because sooner or later it will get dried up by the sun, converted into dust, blown about in the air, and ultimately find its way into the water supply. When tanks are the chief or only source of supply of drinking water to a community they should be reserved for that purpose only. They should be as deep as possible, so that the water may be kept cool and every precaution taken to keep them from being polluted.

How to Purify Water. It has been already observed that water from springs, deep wells, certain hilly districts and lakes, rain water, pipe water supplied by municipalities are, as a rule, reliable and safe to use for all domestic purposes. If there is any doubt, however, as to the purity of water, steps should be taken to purify it. There are several ways in which water may be purified.

Distillation. This was described when dealing with sea water, under the heading "Sources of Water Supply."

Boiling. Boiling for ten minutes will destroy almost every known form of disease germs which water may contain. Repeated boilings will make the most impure water

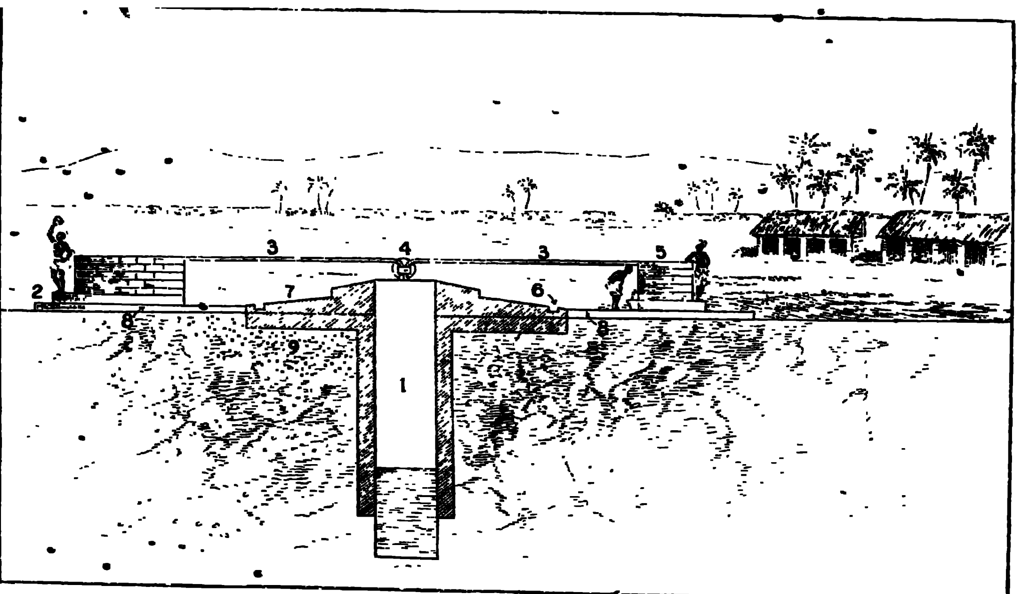


FIG. 31.—SHOWING HOW THE POLLUTION OF THE WATER OF WELLS MAY BE PREVENTED.

1. Well with masonry walls 2. Bathing platform at a safe distance. 3. Water pipe. 4. Pump. 5. Drinking water in cistern with cover and tap. 6. Drain for waste water. 7. Masonry pavement around well. 8. Ground surrounding pavement 9. Surface water kept out of well

perfectly safe to drink. When water has been boiled it must not be allowed to stand unused too long, and must be protected against the entrance of dust and other impurities. This can best be done by keeping it in stoppered bottles. Water which has been boiled is not so palatable as unboiled water. It is, however, safe, which is much better. In order to make water which has been boiled more palatable it is often recommended that it should be well shaken, so as to mix it with the air. This, however, renders the water liable to pollution by disease germs, and should therefore be avoided.

The Use of Chemical Substances. Alum clears muddy water by carrying the mud and other suspended matters to the bottom of the vessel containing the water. Alum is even believed to be able to kill or prevent the growth of germs. Six grains of alum to a gallon of water are sufficient. Permanganate of potassium is, however, the best of all chemical substances. Its use is believed by some people to be the best means of cleansing the water of wells which are believed to be infected with cholera germs. Mr. Hankin, who has given the question a great deal of attention in his pamphlet on the cause and prevention of cholera gives the following directions for the treatment of wells with this substance:

"Care should be taken to explain to the villagers that permanganate is a salt-like substance in whose preparation only mineral substances are employed, and therefore its use ought not to be objected to by the strictest Hindu.

"The villagers should be warned against the danger of drinking any water except that from treated wells. It should also be explained that the permanganate is not a medicine for patients, but merely a means of cleansing water.'

"Put two ounces of permanganate in the solid state into

a dol or bucket that has been filled with water from the well about to be treated. Stir it up and pour the red solution thus produced into the well, leaving the portion of permanganate that is not yet dissolved at the bottom of the dol. Lower the dol into the well, draw it up, pour back the water as before. Repeat the process till all the permanganate has been dissolved. After half an hour draw up some of the water and examine it. If a red colour is still present enough has been added. If the red colour has disappeared, then more permanganate should be added to the water in the well. In all cases enough permanganate should be added to produce a faint red colour lasting 24 hours.

"If the water in the well is bad, more permanganate will be necessary. In such a case it will be found that the strong red colour at first produced slowly changes to brown, and then fades away. This is because permanganate and dirt destroy one another. Therefore, more permanganate must be added in order to produce a lasting colour. If the water in the well is clean a smaller quantity of permanganate will be found to be sufficient. From one to eight ounces of solid permanganate will be found to be sufficient for ordinary wells. If possible the permanganate should be added at night in order to leave the wells undisturbed as long as possible. The water will be fit to drink on the following morning. If at this time the water has the red colour it will have a slightly unpleasant taste, but it is perfectly harmless. If the inhabitants do not like the taste, they should be instructed to pump out the water until the colour vanishes. Always care should be taken to treat with permanganate all the wells in the place, not only those used for drinking, but also those used for washing purposes. The village police may be employed to show the operator the positions of the different wells.

After, but not before, these wells have been found and treated, search should be made for a well near the police station that the police will have forgotten to show. This well or any other suitable wells should be treated with a double quantity of permanganate. Bhisties may then be employed to pump out its water until the colour has nearly vanished. The inhabitants should be advised only to use this well until the following morning, when the water of the other wells will be fit to drink. The well thus selected for immediate use may afterwards be further treated with permanganate.

"Usually water is stored in the houses in ghurrahs for washing and other purposes. This should be poured away, and, if possible, the inhabitants should be persuaded to wash their *lotas* and other vessels with water containing permanganate. Unless this be done, isolated cases of cholera are likely to occur even four or five days after the treatment of the wells."

Filtration. The purification of water by means of filtration is safe only in the hands of persons who possess an intelligent knowledge of the construction of filters, how they act, how they should be used, and how they may be kept in safe working order. The great majority of people know nothing about them, and hence the use of filters for domestic purposes is often fraught with the greatest risk to health. The writer had occasion not long ago to inquire into an outbreak of enteric fever on a steamer in the port of Calcutta, which was shown by a skilled bacteriologist to be due to the use of water from a small domestic filter, which was highly polluted. No less than eighteen persons were attacked with the disease. Charcoal and sand are used in that well-known simple and cheap Indian filter, which consists of three earthenware vessels (ghurrahs), arranged one above the other in a wooden frame.

The purification of water by filtration, through sand,

depends upon the presence of numerous small living vegetable bodies, which form a slime upon the surface. Sooner or later the slime becomes so compact as to prevent the water passing through. When this happens some of it has to be scraped off. When new sand is used the water which passes through it is not safe to use until this layer of slime has formed. Twenty-four to forty-eight hours are generally sufficient for this purpose. Thorough cleansing of the sand before use, however, will make it fairly safe even before the slime has formed. In Germany the filtered water is not served out from a newly made filter-bed, but returned to the settling tanks until a fresh growth has formed, and the bacteria reduced to 50 per cubic centim. (Willoughby).

The use of the ordinary cheap domestic filters, now described, and those most generally to be found in households, should be abandoned. It would be far better to get rid of solid particles of matter, and then merely boil the water. If, however, domestic filters are used at all, the Pasteur-Chamberland or the Berkefeld filter should be preferred. The filtering material in each of those filters consists of hollow cylinders or candles closed at one end, and having at the other fine earthenware or metal caps, through which the filtered water passes. The candles of the Pasteur-Chamberland filter are made of porcelain, a very fine form of earthenware, and asbestos, which is a mineral fibrous substance. The candles of the Berkefeld filter, on the other hand, are made up of compressed and baked earth, consisting chiefly of the hard flinty skeletons of infinitesmally small organisms called diatoms. They have been described by the Berkefeld Filter Company as being hardly larger than the bacteria which they are meant to catch. The Berkefeld filters give a flow of water through the candles five to ten times as rapid as the Pasteur-Chamberland, the reason assigned being that the candles are

porous to the highest degree. The Berkefeld Filter Company observe that in this large supply of perfectly pure water, together with its absolute certainty of retaining on its surface all disease germs, rests the great practical value of the Berkefeld filter to the public.

The main objections which have been stated against the use of the Berkefeld filter are, that the candles are easily broken and their replacement is expensive, and that they require to be boiled every day or two to be made quite safe for use. On the other hand, it is stated that the Pasteur-Chamberland filter is difficult to break, and may last, with care, for months at a time. It is also easy to clean, and, as the *British Medical Journal* observes, the application of the Pasteur germ filter for water for some years in 200,000 quarters of the French Army has shown that it is effectual in preventing epidemics of cholera, typhoid fever, diarrhœa, and similar diseases. Drs. Sims Woodhead and Wood, in their report upon filters published in the *British Medical Journal* of December, 1894, say:

"The Pasteur filter does prevent the communication of water-borne diseases, as is claimed by the vendors. Almost all other filters may materially increase the risk of acquiring infectious disease, and are to be looked upon as an unmitigated evil."

The *Lancet* has also observed that the purifying efficiency of the Pasteur-Chamberland tube is also attested by practical experience, and that the use of the Pasteur filter is a real preventive of water-borne disease. On the whole, the bulk of the evidence regarding the respective merits of the two forms of filter above described is in favour of the Pasteur-Chamberland. These filters may be made of earthenware, stoneware, or enamelled iron, and may be either plain or decorated. They are made in many different forms, of different sizes, and to serve various purposes.

They may be so small as to be easily carried in the pocket, or large enough to supply water to an entire village or town. They may be attached to municipal water service pipes, or used for sterilising liquids of all kinds, including even beef-tea. Great care should be taken to avoid the use of broken candles.

How to Clean the Candles. They may be rubbed with a piece of clean rough cloth or with a brush. They should then be boiled for an hour, or they may be passed through the flame of a spirit lamp or baked in front of a hot fire. Great care should be taken in replacing the candles after cleaning them, otherwise they will allow the water to pass through unfiltered.

FOOD AND DIET.

Every act which we perform is accompanied by loss of body tissue. The food which we eat replaces this loss, produces warmth, and supplies the power to do work.

Composition of Food. Food may be either liquid or solid in form. Whatever its form, a good nourishing diet must contain a certain quantity of water, albumen, carbohydrates, fats, and salts.

Water. The greater portion of solid food consists of water. Potatoes, for example, contain 75 per cent. of water. In addition to the water contained in our food, four pints or more of drinking water are required daily to keep us in good health. In hot countries very much more is required to make up for the great loss of fluid through the skin.

Albumen. The white of an egg consists chiefly of this substance; so also does the curd of milk. It is also found in muscle and in blood, and in peas, beans, dhal, and all cereals, such as wheat, oats, and rice. Foods containing albumen are called albuminates or nitrogenous foods, because they contain nitrogen, which is not found in any other

class of food. Albuminous food is used chiefly for the repair of the tissues of the body, growth, and giving strength. Albuminates are sometimes called flesh formers or proteids.

Carbo-hydrates contain carbon, hydrogen, and oxygen. They do not contain any nitrogen, and are sometimes for this reason called non-nitrogenous foods. Starches and sugar belong to this group. Rice, sago, potatoes, arrow-root, wheat, millets, Indian corn, cane sugar, and beet sugar are the best known examples. Rice contains no less than 83 per cent. of carbo-hydrates. Starchy food of this kind is converted into a form of sugar called grape sugar, through the action of the saliva, which continues for a short time after the food has passed into the stomach. Food of this kind should be well chewed and mixed with the saliva before being swallowed. Infants under six months old cannot digest starchy food, because no suitable ferment is formed in the digestive system until the age of nearly one year. Heat and energy are obtained from carbo-hydrates. Fat is said to be formed, but this is now regarded as doubtful.

Fat. Butter and oil, such as mustard and cocoa nut oil, are the best known forms of fat. The fatty covering under the skin and the fat deposited elsewhere in our bodies is got to some extent, probably, from the starchy and fatty foods we eat. Albuminous foods, however, it has been contended by some writers are the chief source of the fat stored up in the body. Fats taken as food produce twice as much heat as carbo-hydrates, and are therefore extremely useful in cold climates. They also help to strengthen the body. The digestion of albumen is very much helped by the presence of fat. The white of an egg is thus more easily digested when taken with butter. Cod-liver oil in small doses is, for the same reason, given in such cases where the stomach is weak and digestion bad. Cod-liver oil is, moreover, highly nutritious.

Salts. A salt is a chemical substance formed by the combination of an acid with a base. Common salt, which is a combination of sodium and chlorine, is the most useful and the most largely used salt and the best example Lime salts are consumed to a large extent in India with *pan*. Salts of different kinds are contained in varying amount in the vegetables and fruits which we eat. Bones would become soft without them. The disease, known as rickets, is due to a deficiency of lime salts in food or water. It is owing to an insufficient supply of iron salts, which are of great benefit to the blood, that people sometimes look pale and unhealthy. It was due to the want of vegetables, which contain certain salts, that severe outbreaks of a disease called scurvy were so common among sailors during long sea voyages in past years. Lime juice, which contains the necessary salts, is now carried in all ships as a substitute for vegetables when they run short. Salts are also required for the formation of the juices with which our food is digested. A diet, which consists of 5 ounces of nitrogenous food, 15 ounces of carbo-hydrates, 3 ounces of fat, and 1 ounce of salts daily, is the most perfect diet for a man doing an ordinary amount of work. Some writers, however, would allow only 4 ounces of nitrogenous food, 8 ounces of carbo-hydrates, 2 ounces of fat, and one-half ounce of salts. It has been calculated that if a hundred prisoners were fed on bread alone they would require daily 380½ pounds to make up the loss of carbon and nitrogen from their bodies. Three hundred and fifty-four pounds of flesh would be required if flesh alone were given. If, however, both bread and meat were given, 200 pounds of bread and 60 pounds of meat would be sufficient. The chief thing to bear in mind is that it is impossible to remain in good health if an insufficient supply of any one of the principal elements of food is consumed.

DIFFERENT KINDS OF FOOD.

Animal Food. Milk. Milk is one of the most valuable articles of food in both sickness and health. It is the best food for infants, because it contains all the elements of a perfect diet in the right proportion, and is easily digested. Infants should be fed solely on milk until they are nearly one year old. Grown-up people may be kept alive by milk during sickness for several weeks at a time. Several pints, however, may be required daily in these cases. The addition of a little sugar makes milk more suitable as an article of diet. The natural food of infants is human milk. Cow's milk, made as much like human milk as possible, is, however, by dilution with water and the addition of a little sugar, sometimes given to very young children. Ass's milk, which more closely resembles human milk than does that of the cow, is also of great use, but expensive. Older persons use cow's milk a great deal. The use of goat's and buffalo's milk is very common in India.

Composition of Milk. All kinds of milk contain a large amount of water, varying from 81 to 90 parts per 100 parts, and from 1 to 7 parts of fat, which forms the cream when milk is allowed to stand. There is more albumen (from which the casein or curd is formed) than fat in milk. Sugar and salts are also contained in milk in small quantity. Butter is made from the fat of milk and cheese from the albumen or curd. In making cheese, however, the fat is sometimes retained.

Diseases caused by Milk. We already know that cholera and other diseases are often caused by the addition of polluted water to the milk. This practice is very common. Pain, sickness, vomiting, and diarrhoea are often caused by milk which has turned sour. European children

who are brought up bottle-fed often suffer from symptoms of the kind because their bottles are not kept clean. Feeding-bottles should not have tubes because they cannot be kept clean. Consumption of the bowels and scarlet fever may also be caused by using infected milk.

How to prevent Disease being conveyed through Milk. The milk of healthy cows only should be used. Water should never be added except when necessary in the case of infants and sick persons. Milk vessels should not be washed with dirty water. Boiling water only should be used for this purpose. Cases of epidemic disease occurring near dairies or places in which milk is sold should be immediately removed to some safe place for treatment. Cows should not be milked by people with dirty hands. Milk should always be boiled before it is used. Milk, as in the case of water, should not be kept standing too long after it has been boiled. It should be covered to keep out dust, in which the germs of disease are, as we know, often carried, and also to keep out flies which may infect it.

Eggs. Eggs also contain all the elements of a perfect food. They contain albumen and fat in large amount. The white of one egg is said to be equal to three teaspoonfuls of a beef extract. Fresh eggs only should be used, as stale eggs can be thoroughly poisonous.

Flesh. Flesh is highly nutritious. It consists of water 75 per cent., albumen 20 per cent., and fat 5 per cent. It, however, contains hardly any carbo-hydrates. Beef, mutton, fowls, and fish are the forms of animal food chiefly used in India. Beef extracts are extensively used in cases of sickness. They are merely stimulants, however. Dr. Hutchison, a distinguished writer on food, says that, as far as nutrition is concerned, one can prepare at home equally good beef juice at much less cost, in one instance at a 200th part of the expense of the fashionable article. It is really pathetic,

says Dr. Hutchison, to see poor people in cases of illness paying large sums for so very small a return. The great majority of the natives of India are not flesh eaters. The only real objection to the use of vegetables only is that the stomach has to be distended to its utmost limit three times daily in order to obtain enough nourishment for the system. Dr. Hutchison maintains that the use of a strictly vegetable diet means a low standard of life, of energy, and resistance to disease. Much time and energy are, moreover, wasted in digesting so much vegetable matter. The use of flesh in too large amount causes gout and nervous irritability. The flesh of immature is not so nutritious as that of full-grown animals.

Signs of Good Meat. The flesh and fat should be fresh, firm, tender, of reddish colour, and healthy looking. Wholesome meat should not contain too much blood. The fat should be bloodless. Meat should be of the same quality throughout its entire substance. Softening, offensive smell, and greenish discoloration indicate that meat is bad and unfit for human use.

Vegetable Foods. These have been divided into six classes:—1st. Farinaceous foods or cereals, such as rice, wheat, barley, maize and millet. 2nd. Pulses, such as dhal, peas, and beans. 3rd. Roots and tubers, such as potatoes, beetroot, carrots, turnips, tapioca, arrowroot, and ground nuts. 4th. Green vegetables, such as spinach (sag), asparagus, brinjals, cauliflower, and cabbages. 5th. Fruits, such as oranges, grapes, mangoes, lemons, guavas, papiyas, and plantains (Reynolds). 6th. Fungi, a class of food to which mushrooms belong. Farinaceous foods, and rice in particular, pulses, and tubers are largely consumed by natives of India. Rice and dhal form the sole articles of diet in numerous instances. The consumption of rice, ghee, and sweetmeats in large quantity causes stoutness in persons of inactive habits.

People who live chiefly on food of this kind are generally of poor physique, cannot exert themselves much without getting exhausted and out of breath. Dhal, peas, beans, and wheatflour made into chapatties should form a portion of the dietary of rice eaters, because rice contains small quantities only of albumen and fat, whereas pulses and wheatflour are rich in albumen, which is so necessary to the maintenance of good health. Chapatties should be made thin, so that they may be well cooked. Stoutness and weight can be much reduced by the use of these articles of diet in the manner suggested. There are various kinds of dhal, of which urhur, mussoor, moong, and gram dhal are perhaps the best known. The last is the least wholesome of these four kinds. Kasaree is another pulse in common use, which, however, has a bad reputation. They may be taken instead of flesh. Fish may also be used to supply some of the nitrogen required. Milk and oatmeal porridge or wheatflour would enable us to perform hard work for a long time. Indian corn (maize) contains more fat than oatmeal, and is perhaps for this reason a better article of diet if well cooked.

Vegetables contain water, acids, and salts. They should always be fresh and carefully washed, and they should generally be well cooked. Uncooked vegetables should be very thoroughly cleaned before being eaten, as they may contain small worms, or the eggs of insects, or the germs of disease of various kinds.

Fruit contains water, in large amount, acids, and salts. Sugar and oil are also contained in many kinds of fruit. Fruit should never be eaten unless when fresh, ripe, and clean. Over-ripe, decaying, or unripe fruit causes disease of the stomach and bowels. Fruit which has been preserved in tins may cause similar symptoms owing to the presence of lead, tin, copper, or

other substance absorbed by the juice from the metal of the can.

Preservation of Foods. Food is sometimes preserved by freezing, or by using currents of cold air, as in the case of the carcases of cattle and sheep. Food may also be preserved in ice. Alcohol, vinegar, and other substances are often used for the purpose. Beef for the use of sailors is often preserved in brine. Drying is sometimes resorted to, as in the case of fish, vegetables, and fruit. Foods of almost every description, such as milk, fish, fruit, and jams, are also sometimes preserved in tins or bottles hermetically sealed after all the air has been expelled by heat. If gas escapes when a tin is opened the contents are bad. Badly preserved foods are exceedingly dangerous to use. They give rise to symptoms of poisoning, which closely resemble cholera. This is known as ptomaine poisoning.

Adulteration of Food. Water may be added to milk, or the cream may be removed and flour or other similar starchy food added to give the milk a thick appearance, or sugar or salt may be added. Plantains and meat fat and other substances are often added to butter, ground maize to flour, and sand to sugar. Ghee is often adulterated with ground-nut, cocoanut, or poppy oil. Arrowroot may be mixed with cocoa and chocolate, or the starch granules of potatoes, rice, sago, or tapioca may be used. Alum is often added to bread to give it a white appearance. Tea leaves are sometimes mixed with other kinds of leaves or with tea leaves which have already been used. These are a few examples of the manner in which food supplies may be adulterated. The practice of adulterating food supplies is perhaps more common in India than in any other country in the world. Of all forms of adulteration that of milk with polluted water is, perhaps, the most to be feared.

Cooking. Food is cooked to soften it, to make it more

attractive and more easily digestible, and thus fit it for the nourishment of our bodies. Cooking also destroys small parasitic and other animals, their eggs, and the germs of disease. Cooking also enables certain kinds of food, such as milk and meat, to be kept for a considerable length of time without turning bad or becoming unfit for use.

Methods of Cooking. Food may be boiled, steamed, roasted, baked, fried, grilled, or braised. The method of cooking food should be varied as much as possible, otherwise it will lose its relish. Every attention should be paid to cleanliness. Cooking pots which are made of copper should be regularly tinned, otherwise there is danger of some of the copper being dissolved and causing poisoning. Cooking vessels made of aluminium are to be preferred to those made of copper. Rice and other starchy foods should be cooked slowly, and green vegetables quickly. Well-cooked rice is soft and free from lumps. Each particle should be separate. Mustard oil is often used in India for cooking purposes, chiefly because it is cheaper than butter. Dhal should be very carefully cooked, otherwise it will cause irritation of the bowels.

Length of Time required to Digest what we eat. This varies greatly. Boiled rice, for example, is digested within one hour. Boiled cabbage requires four hours. Roasted potatoes take 2½, and boiled potatoes 3½ hours. Indian corn bread, baked, takes 3¼ hours. Raw eggs are digested within 1½ hours, roasted eggs in 3½ hours, and hard boiled eggs also in 3½ hours. Fried beef, boiled fowls, roasted fowls, and roasted duck take four hours, while roasted pork takes 5¼ hours.

(For the digestibility of some other articles of food see the following tables):

RELATIVE DIGESTIBILITY OF ANIMAL SUBSTANCES.
(RUSSELL.)

ARTICLES OF DIET.	HOW COOKED.	TIME OF CHYLIFICATION. Hour.	Minute.
Pig's feet (soused)	Boiled	1	0
Tripe (soused)	Boiled	1	0
Eggs (whipped)	Raw	1	30
Salmon trout	Boiled	1	30
Venison steak	Broiled	1	30
Brains	Boiled	1	45
Ox liver	Broiled	2	0
Cod fish (cured dry)	Boiled	2	0
Eggs	Roasted	2	15
Turkey	Boiled	2	25
Gelatine	Boiled	2	30
Goose	Roasted	2	30
Pig (sucking)	Roasted	2	30
Lamb	Broiled	2	30
Chicken	Fricasseed	2	45
Beef	Boiled	2	45
Beef	Roasted	3	0
Mutton	Boiled	3	0
Mutton	Roasted	3	15
Oysters	Stewed	3	30
Cheese	Raw	3	30
Eggs	Hard boiled	3	30
Eggs	Fried	3	30
Beef	Fried	4	0
Fowls	Boiled	4	0
Fowls	Roasted	4	0
Ducks	Roasted	4	0
Cartilage	Boiled	4	15
Pork	Roasted	5	15
Tendon	Boiled	5	30

RELATIVE DIGESTIBILITY OF VEGETABLE SUBSTANCES (RUSSELL).

Articles of Diet.	How Prepared.	Time of Chemification Hour.	Minute.
Rice	Boiled	1	0
Apples (sweet and mellow)	Raw	1	30
Sago	Boiled	1	45
Tapioca	Boiled	2	0
Barley	Boiled	2	0
Apples (sour and mellow)	Raw	2	0
Cabbage, with vinegar	Raw	2	0
Beans	Boiled	2	30
Sponge cake	Baked	2	30
Parsnips	Boiled	2	30
Potatoes	Roasted	2	30
Potatoes	Baked	2	33
Apple dumpling	Boiled	3	0
Indian corn cake	Baked	3	0
Indian corn bread	Baked	3	15
Carrot	Boiled	3	15
Wheaten bread	Baked	3	30
Potatoes	Boiled	3	30
Turnips	Boiled	3	30
Beets	Boiled	3	45
Cabbage	Boiled	4	0

The greatest attention ıould be paid to cleanliness during cooking. Smoking should be prohibited, and servants, other than the cooks and those who assist in cooking, should not be allowed in the cookhouse, and no one should be allowed to sleep in the cookhouse. Cooking utensils should be cleaned with boiling water, immediately after and before use, and on no consideration should dishcloths, which have not been carefully boiled, be used. There should be an abundant supply of wholesome water for cooking purposes. Articles of food, such as vegetables, should be well washed before being cooked. Everything

about the cookhouse, including the floor, wall, and ceiling, should be kept spotlessly clean, and only cooks who are cleanly in their habits should be employed.

Eating. Everything we eat should be fresh and wholesome, eaten slowly, and well chewed, so as to thoroughly mix it with the saliva, which is formed chiefly during eating. Quick eating causes over-loading of the stomach and indigestion. Food should be eaten as soon as possible after it is cooked. If it is allowed to stand it becomes cold, and may be polluted by flies or dust. If it is necessary to let cooked food stand for a time it should be carefully covered. It is a common but dirty and dangerous practice, in India, for several persons to eat out of the same dish. When possible each person should eat out of a separate dish. The hands should be thoroughly cleaned before eating, more especially the nails, under which dirt and disease germs may lurk. Leaves should not be used instead of plates. If used at all, they should not be used a second time. Our meals should be taken at regular hours daily. Rooms in which we eat should be large and clean, and all the members of a family should sit down to their meals at the same time. A short rest from labour is desirable both before and after meals. It is not good to eat between meals. An interval of 5 or 6 hours is required. No heavy food should be eaten just before going to bed. In hot countries, and during hot weather in cold countries, meat should not be taken in large quantities. Fruit and vegetables are better. The amount of food required to keep the body in a healthy and active state will depend upon the amount and nature of the work which has to be done. We should, however, be careful to avoid eating either too much or too little.

Time of Eating. No rules can be definitely fixed. As a general rule three meals are taken daily by Europeans and two by Natives of India. Children should be fed at inter-

vals of three and adults of five hours. Very young children and sick persons require light and nourishing food often and in small quantities.

Drinks. Water from a pure source is the safest and best liquid to drink. Alcohol, it has been contended by some, is a food, prevents waste of body tissue, strengthens the muscles, prevents loss of heat, and keeps out the cold. Others contend that it is not a food, that it prevents the waste products of the body being got rid of, and in this way increases the weight of the body, that it simply paralyses the muscles so that the person who takes it does not know that he is tired, that it protects against neither cold nor heat, but that the temperature on the other hand falls below normal after taking alcohol, and that it is in no sense of the term a stimulant. People who indulge freely in the use of alcohol become blotched in appearance, acquire a craving for it, and often become drunkards. Much of the poverty, distress, and many of the mental and physical ailments which exist in the world are due to the abuse of alcoholic liquors. Among arguments which have been raised against the use of alcohol, it has been stated that it undergoes no change when taken into the system, that it is alcohol in the still, alcohol in the stomach, alcohol in the blood, alcohol in the brain, in the liver, in all the tissues, alcohol in the breath, in the perspiration, and in all the excretions. In short, that alcohol is not used in the body, but leaves it as it enters, a rank poison. While this, however, is not quite the case, it is a fact that not more than, perhaps, two ounces of absolute alcohol can be made use of daily by the system, without any traces appearing in the excretions. According to the most recent inquiries into the subject, it is a serious mistake to take alcohol even in the smallest quantities. Professor Horsley declares that it is hurtful even when taken as an article of diet,

and that, while it stimulates temporarily, it does so by deranging the brain machinery, the wheels going more quickly, as it were, because of the loss of controlling power, and that paralysis or benumbing follows. It is otherwise with tea or coffee. These are good stimulants, and may be taken instead of alcohol when one is tired. So may meat extracts. One quarter pound of oatmeal in three or four quarts of water, with an ounce of sugar, well boiled, has been highly spoken of as good for quenching the thirst and enabling a person to perform an unusual amount of continuous labour. (Russell, Edinburgh.)

Toddy and arrack are the forms of liquor chiefly used by natives of India. They are often adulterated with poisonous drugs, such as dhatura, opium, and Indian hemp, and are very harmful. It is safer to avoid altogether the use of alcoholic liquors, or to use them only under skilled medical advice.

Condiments. These are taken with food to increase the secretion of saliva in the mouth and gastric juice in the stomach. If taken in excess they irritate and produce disorders of the alimentary canal. Some of them are extremely useful in cases of colicky pains in the belly, and for many other purposes. They are often harmful, however, in certain cases even when taken in moderate amount, and should never be given to children. The best known condiments are mustard, chillies, pepper, ginger, cloves, cardamoms, and nutmegs.

LOCAL CONDITIONS.

Soil. Soil consists of particles of mineral matter derived from rocks, such as granite, and chalk, and the waste products of plants and animals. The broken-up part of the rock immediately under the soil is called the subsoil.

The surface portion of the soil contains germs, which set up certain chemical changes in the vegetable matter, which is converted into food suitable for the sustenance and growth

of plants. This food consists of the gases and other products which are given off during decomposition. If they were not used up by plants such products would be injurious to health. This explains the benefit of bringing trenching grounds under cultivation, and as is subsequently explained of planting flowers, trees, and shrubs of various kinds in graveyards. The germs of disease, such as enteric fever and cholera, frequently, as we know, find their way into wells, and other sources of water supply by percolating through the soil.

When there is an absence of water from the soil, air takes its place. The amount of air present depends upon the nature of the soil. A loose sandy soil, for example, may contain as much as 50 per cent. The ground air and gases derived from sewers, drains, and other foul places may travel great distances in the soil, find their way into dwelling rooms, and give rise to diseases of a very dangerous nature. It is to keep air of this kind out of houses that floors are made of masonry and houses are sometimes built on arches. Further, it is to escape breathing such gases that raised beds are used for sleeping in, instead of lying on floors. The dangers of made soil as building sites and of damp soil were pointed out in a former chapter.

Climate. The term climate is used to indicate the meteorological conditions of a place, such as temperature and its variations, the humidity or dryness of the atmosphere, the rainfall, the prevailing winds, the character of the soil, and water supply. Climate depends to a large extent upon the geographical situation of a place, and its latitude. For these reasons climates have been classified as warm, temperate, cold, mountain, and marine climates. It is a familiar fact that certain diseases are peculiar to certain climates. They have for this reason been called "climatic diseases." Many diseases, however,

attributed to climate are often caused by careless living and violation of the laws of health, but there is nothing to show that climate is the direct cause of illness; in fact, the human system adapts itself in a wonderful manner to almost any kind of climate. Heat and moisture are the two most essential and potent causes of decomposition in all animal and vegetable matter. It is due to these conditions that meat and fruit go bad so quickly, and so often give rise to bowel complaints. We also know that heat and moisture are favourable to the growth of the germs which cause diseases, such as cholera. Hence it is that cholera and dysentery are so common in India. Such diseases can be prevented to a large extent by the use of a pure water supply and improved hygienic surroundings generally, by eating only wholesome food, and by living a regular and careful life in every other respect.

METEOROLOGY.

Meteorology has been defined as the science of the phenomena of the atmosphere. It includes atmospheric pressure, humidity and temperature, winds and their causation, velocity and direction, and rainfall.

Atmospheric Pressure. The barometer is an instrument which has been devised for ascertaining variations in the pressure of the atmosphere. A column of mercury, which varies in height with the pressure of the superincumbent atmosphere, is sometimes used for this purpose. The mean weight of a column of the atmosphere at freezing point and sea level has been ascertained to be the same as the weight of a column of mercury thirty inches high and of the same sectional area as the column of the atmosphere. The pressure of the atmosphere under those conditions is 14·7 pounds pressure to the square inch.

Humidity. There is always in the air a greater or less amount of moisture. This is spoken of as the humidity of the atmosphere. A heated atmosphere can hold a much larger quantity than a cold one. Hence it is that moisture condenses on cold surfaces, such as that of a glass containing ice, and evaporates when exposed to heat. When the atmosphere at a given temperature contains as much moisture as it can hold it is said to be saturated. The amount of moisture in the air varies greatly in different countries, and even in different parts of the same country, and very markedly so in India. The air, for example, in the dry sandy desert of Sind and other parts of Northern India is at certain seasons of the year so dry as to cause the skin to crack, while in some parts of the Presidencies of Bengal, Madras, and Bombay the air generally is saturated. The perspiration in consequence flows freely from the skin, and evaporation being checked, great discomfort and fatigue are produced. Some delicate people with weak chests and other diseases enjoy better health in hot, moist climates. As a rule, however, dry climates are preferred. The temperature at which air begins to deposit its moisture is known as the dew-point, and the instruments which are used for ascertaining the amount of moisture in the atmosphere are called hygrometers.

Temperature. The temperature of the atmosphere varies greatly in different countries. It also varies with the season of the year and time of day. Despite these variations, however, the temperature of the human body in a state of health is maintained at an almost constant level. The normal temperature of the body is about 98·6° Fahrenheit. If the temperature of the atmosphere rises to a great extent, so also, but to a very small extent, does the temperature of the body.

Perspiration is the chief means whereby the temperature

is kept at its normal level. Radiation and conduction of heat also help considerably. Prolonged exposure to great heat or great cold sooner or later destroys the tissues of the body, or may even cause death. The instruments used for ascertaining temperature accurately are called thermometers. Mercury, which boils only when great heat is applied, is used for recording high temperatures or temperatures above the normal, and alcohol, which does not freeze, to record

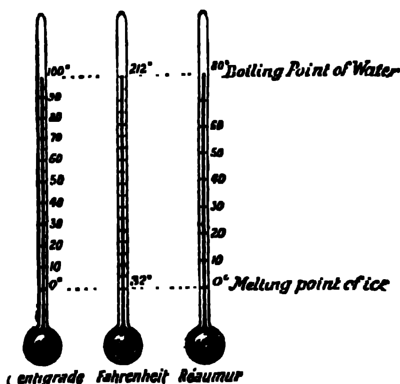


FIG. 32.—THERMOMETRIC SCALES

low temperatures. In thermometers the lower limit is called zero, which in two forms of thermometers, called the Centigrade and Reaumur respectively, is the melting point of pure ice or the freezing point of pure water, which is the same thing. The upper limit in these two forms, and also in a third form, called the Fahrenheit thermometer, is the boiling point of water at the sea level. In the latter thermometer, however, the freezing point is 32 degrees. The boiling point in the Fahrenheit thermometer is 212 degrees. Between these two points the stem of thermometers is divided into units or degrees. The stem of the

Centigrade thermometer is divided into one hundred, that of the Reaumur into eighty only, while that of the Fahrenheit is divided into 180 degrees or units between the freezing and boiling points. The temperature is said to be so many degrees Centigrade, Reaumur, or Fahrenheit, according to which of the three scales is adopted. (Fig. 32.) Thermometers specially constructed to record the lowest temperature of the atmosphere in a given period of time are called minimum, and those constructed to show the highest temperature in a given period of time are called maximum thermometers. Thermometers are also made for use in sick rooms and for ascertaining the temperature of hot water used for bathing and other purposes. There are also what are called shade and sun thermometers, and thermometers for measuring the heat given off by the earth (terrestrial radiation thermometers).

Winds. When dealing with the subject of ventilation it was pointed out that hot air being light tends to rise and escape, and that the heavy cold air rushes in to take its place, and thereby causes strong draughts. Winds are caused in the same way, the chief agency being the sun's rays, which heat the atmosphere of certain portions of the earth's surface during its rotation, while other portions are unaffected by them and remain comparatively cold. The velocity of the wind depends upon the differences in the atmospheric pressure, and varies from a scarcely perceptible movement to a velocity of over seventy miles, amounting to what is termed a hurricane. Anemometers are small instruments by which the velocity of the wind is determined. Cold winds are dangerous to health unless our bodies are well protected by warm clothing.

Rainfall. We have already learned that when warm air containing moisture comes in contact with a cold object the moisture is deposited. Rain is caused in a similar

manner by currents of cold air coming in contact with warm moist air, or when the warm moist air comes in contact with the tops of cold mountains. The heavy rains during the south-west monsoon in India is caused in this way by condensation of the moisture in the hot moist winds blowing from the Indian Ocean coming into contact with the cold mountains along the west coast. The rainfall varies greatly in the different countries and parts of the same country. The rainfall, for example, in some parts of India may not exceed 60 to 70 inches in the year, while on the Assam hills as much as 600 inches may fall yearly. On the other hand, there may be no rainfall at all in certain places throughout the entire year, as, for example, in Aden and some parts of Sind, where the average yearly rainfall may not be more than a very few inches. We have dealt with the subject of scanty rainfall and the evils caused by it. The level of the ground water depends largely upon the amount of the rainfall, and the health of people to a large extent upon the depth of the ground water level. The amount of the rainfall is ascertained by collecting the rain in rain-gauges and measuring the quantity collected in a given time.

INFECTIOUS AND CONTAGIOUS DISEASES.

Diseases of this kind are popularly spoken of as "catching diseases," in the same sense as we speak of catching a cold. These diseases may be spread (*a*) by direct contact, (*b*) through the air, (*c*) through water, (*d*) by food, (*e*) by clothing. Small-pox, plague, and skin diseases, such as itch and ringworm, are good examples of diseases which may be conveyed by direct contact, and are for this reason called contagious diseases. Small-pox and plague can also, however, be conveyed through the air. Measles and mumps

are other examples of diseases which can be conveyed through the air. Small-pox, plague, measles, and mumps, and nearly all diseases of this class, can, moreover, be conveyed by means of clothing. Diseases which are conveyed through the air and by means of clothing are called infectious diseases. It will thus be seen that some diseases are both infectious and contagious, and either of

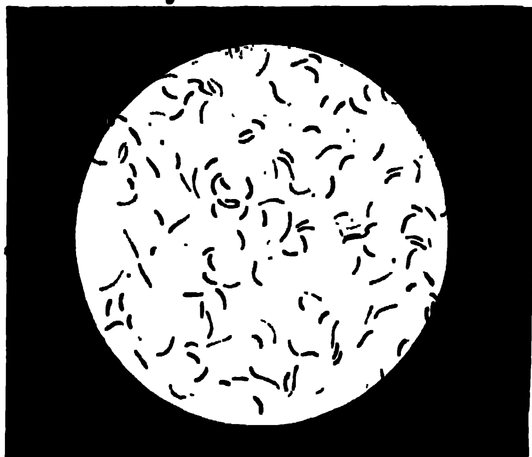


FIG. 33.—BACTERIA OF CHOLERA. (× 1500.) (Reproduced from a photograph taken by Mr. J. E. Barnard.

these two terms is often, for this reason, used to mean the same thing. Cholera and enteric fever are the best examples of diseases which are water-borne. They may also be caused by polluted milk. Malarial fever may also probably be caused by drinking impure water. Consumption is the best known example of infectious diseases under this heading which may be communicated by food. It may perhaps be induced by drinking the milk or eating the affected portions of cows suffering from that disease,

just as tape-worm is caused by eating the flesh of diseased pigs, but the question is at present the subject of debate.

The Cause of Infectious and Contagious Diseases. Most of these diseases have been proved to be caused by small living bodies called germs or bacteria. They are also called bacilli, microbes, or micro-organisms. These germs are so small that, according to Hankin, if 60 cholera germs were put in a row they would form a line the length of which would be equal to the thickness of a hair. It has also been calculated that if it were possible to string them together 25,000 germs would measure only one-half inch in length. These germs are of various sizes and shapes. They may be round or oval, straight, curved, or even shaped like a corkscrew (Figs. 33 and 34).

They, as a rule, multiply by division. Each germ divides into two; the two divide into four; the four into eight, and so on until there may be millions of them in a single drop of liquid or material on which they feed.

The Conditions under which Infectious and Contagious Diseases spread most rapidly, and how to avoid them. Infectious and contagious diseases spread most rapidly in badly lighted, badly ventilated, and over-crowded houses; in places which are dirty, where the houses are too closely built together, where the water is polluted, and the habits of the people are unclean. It is said that under favourable conditions one germ may multiply and produce as many as 17,000,000 in twenty-four hours. In order to escape being attacked by such diseases it is most important that we should drink pure water and milk, eat good food which has been well cooked, and keep our bodies, clothes, houses, and surroundings clean. The germs of disease grow and multiply most rapidly in the bodies of the weak and unhealthy. In the systems of healthy people

the germs are, as it were, eaten up by the blood, and thus kept from doing harm. The importance, therefore, of living regular and healthy lives is obvious.

Epidemic. The term epidemic is applied to diseases which attack, at or about the same time, many people living in the same town, village, or house, and are capable of being conveyed from one place to another in air, clothing, or otherwise.

Endemic is the term applied to diseases which are always present to some extent in certain places to which they appear to be generally confined.

Sporadic is the term applied to cases of infectious diseases occurring singly or in very small numbers and at irregular intervals in more or less widely separated parts of a town or district, one case apparently having no connection with another.

Period of Incubation. The interval which occurs between the time of infection and of the appearance of symptoms, and during which the disease is quietly developing in the system, is called the period of incubation.

IMMUNITY.

It is a well-known fact that some persons are more liable to be attacked with certain diseases than their neighbours. It is for this reason that diseases are sometimes said to run in the blood of certain families. Such diseases are called hereditary diseases. Consumption of the lung and cancer are good examples. Diphtheria and enteric fever are examples of infectious diseases which are said to run in families. On the other hand, some people who are proof against certain diseases, and are said, therefore, to enjoy what is called an immunity to these diseases. If born in the person, it is called "natural or innate immunity." It

is a well-known fact that one attack of small-pox makes a person very much less likely to be attacked with the disease a second time. Vaccination also protects against small-pox to a large extent. Further, it is with the view of protecting people from being attacked with plague, cholera, and other diseases that inoculation has been so largely practised in India in past years. The freedom from small-pox, conferred

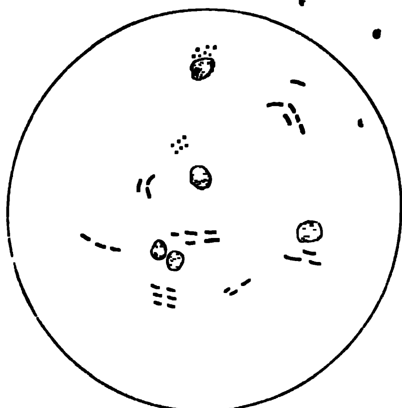


FIG. 31.—BACILLUS OF CONSUMPTION.

by either a previous attack of the disease or by vaccination, and from plague and other diseases by inoculation is known as 'acquired immunity."

SMALL-POX AND VACCINATION.

Small-pox is a disease which attacks all classes of people, but seems to act most severely on dark-skinned races. Children are its most common victims. The disease is marked by several distinct stages, namely :

Stage of Incubation. The period is 11 or 12 days.

Stage of Invasion. For two or three days after this the person has headache, shiverings, pain in the back and legs, sickness or vomiting, high temperature, and occasionally convulsions. This is termed "the stage of invasion."

Eruptive Stage. The rash begins to appear on the face, then the neck and trunk, and finally on the legs and arms. The mouth, nose, eyes, and throat become affected, and cough is a marked symptom. This stage lasts four or five days, and the rash assumes the form of clear small vesicles with a depression in the centre. During this stage the fever becomes less. This stage has been called "the stage of the rash or the eruptive stage."

Stage of Maturation. The vesicles now begin to undergo a change. Instead of remaining clear they become turbid and opaque, and a red ring forms round them. This change is accompanied by another rise in the temperature called the "secondary fever." This stage is termed the period of maturation or ripening of the pocks.

Stage of Dessication. The fifth and last stage is the formation of scabs, which gradually fall off, leaving scars. During this stage the fever abates. This is termed "the stage of dessication," meaning thereby the drying up of the pocks.

Small-pox has different degrees of severity, being sometimes very mild, and ending in recovery. It is often severe, and ends in death from high fever, affections of the chest, or other complications. It often causes permanent and total loss of sight and hearing. Note carefully that a mild case in one person may give rise to a very malignant form in another person.

There is another disease, viz., chicken-pox, which might be mistaken for small-pox, and it is just as well to know something about it also.

Chicken-Pox is a disease which occurs chiefly amongst children. It is attended with a rash resembling that of small-pox. It is contagious, and sometimes appears in epidemic form. The period of incubation may be 10 days, longer or shorter. The rash sometimes appears without anything having occurred to attract attention. There may be, however, slight fever for a few hours, but as a rule not longer than 24 hours, before the rash is visible. The fever is never so severe as in small-pox. The rash comes out in crops of two or three vesicles at different times, so that some may still be quite clear and translucent, while others have already turned turbid from the formation of pus inside. The vesicles are about the size of a split-pea or smaller. The disease reaches its height in from 7 to 10 days, and is all over within a fortnight. Death seldom occurs from it.

With these few remarks on small-pox and chicken-pox we shall proceed to consider vaccination.

VACCINATION.

Vaccination means inoculation with lymph, that is the introduction of lymph into the system as a means of protection against small-pox. It has been called "the new inoculation" in order to distinguish it from a practice which prevailed from very early times, and still prevails in some parts of India, called "inoculation" or "country vaccination," by which the poison of small-pox is introduced into the system of healthy persons with the view of preventing or lessening the severity of an attack of small-pox. This effect has sometimes been obtained, but the practice is liable to spread the disease to an alarming extent, and small-pox contracted in this way has often proved fatal. Hence it is that laws have been passed to prevent

inoculation with small-pox matter, and the practice is now regarded in many countries as a most serious crime.

Inoculation was introduced into England early in the 18th century from Constantinople, the capital of Turkey, and was in use till near the close of the same century, when the immortal Jenner discovered "the new inoculation," now better known as "vaccination."

It became known that the cow was sometimes attacked with a disease called "cow-pox," and that those who milked such cows and got cow-pox curiously enough did not get small-pox, and it is on record that an English farmer named Benjamin Jesty intentionally inoculated his wife and two sons from a cow suffering from the disease as a protection against small-pox. A similar belief is known to have existed in Germany about the same time, when, it is said, a schoolmaster vaccinated two children with the same object in view. Dr. Jenner took up the question, and in the face of much ridicule worked at it till he established its truth, and in 1798 he published the results of his experiments. One writer has said: "In the last century the resulting mortality in some of the countries of Europe was often equal to the entire population of one of their largest cities. If a modern traveller could find himself transported to the streets of the city of London as they appeared in the earlier part of the present century, it is probable that no peculiarities of architecture, dress, or behaviour would be to him so strikingly conspicuous as the enormous number of pock-marked visages he would encounter among the people at every turn."

Since vaccination was introduced matters have assumed an entirely different aspect. A pitted face is now-a-days almost one of the rarest objects to be seen in the British Isles. Unfortunately, the same cannot be said of India.

Thousands of men, women, and children have been blemished for life through ignorance and prejudice, and thousands still obstinately refuse the gift of one of the greatest blessings that science has ever offered them, and most strenuously oppose what is calculated to be for their greatest good. This state of matters is to be very much regretted, but until the importance of vaccination is fully realised, it is the duty of every educated and intelligent person who has the interests of vaccination at heart to endeavour to convince people of its real value by every possible argument in its favour. Vaccination, we must understand, does not always protect against small-pox, nor, indeed, does one attack of small-pox protect against a second attack. Every person should carefully remember these two facts. If, however, vaccination has been successfully performed, the chances are that for a number of years at any rate the vaccinated person is (in the great majority of instances) proof against small-pox. Four good marks may be taken as sufficient to protect for a period of five or six years, in some cases longer, and in others for a whole lifetime. A child with four good pocks has greater security than a child with two, and still greater than a child with one only. The vaccinator who vaccinates unsuccessfully does more harm than good, because ignorant people do not know when vaccination is successful, and believe it to be sufficient if the child's arm is only scratched, and afterwards turns red and forms a scab, and are very much disappointed if their child should get small-pox afterwards. This is one way whereby the confidence of the people is lost and vaccination brought into disrepute by unskilful and careless vaccinators.

The following are the statistics of twenty years of one of the London small-pox hospitals, which bear out the truth of the above statements:

PATIENTS ADMITTED WITH SMALL-POX.

	Number admitted.	Death rate per cent.
1. Having one scar, - - - - -	2001	7·73
2. Having two scars, - - - - -	1446	4·70
3. Having three scars, - - - - -	518	1·95
4. Having four scars, - - - - -	544	0·55
5. Said to have been vaccinated but having no scars, - - - - -	370	23·57

The practice in small-pox hospitals in England is to revaccinate all nurses and attendants. One writer says regarding an epidemic in 1876-77: "All revaccinated attendants have escaped, whilst the only one who had not been revaccinated took small-pox and died of it." Out of 1500 such attendants 43 contracted small-pox, and not one of these 43 had been revaccinated.

The following statement is an extract from a report on an out break of small-pox in Glasgow, and shows the effect of vaccination on the death rate:

EFFECT OF MORTALITY.

Of 623 cases vaccinated, - -	8	per cent. died.
Of 266 cases unvaccinated, - -	31	,,
Patients with good marks, - -	3·8	,,
Patients with bad marks, - -	21	,,
Patients with no marks, - -	30	,,

Revaccination at the age of puberty has practically the effect of abolishing small-pox.

The following suggestions should be carefully observed:

1. As a rule every child should have four good pocks.

2. Revaccination should be done every six or seven years. A person should never pass the time of puberty without revaccination.

3. Revaccination should be done during epidemics of small-pox without regard to the length of time that has elapsed since primary vaccination.

4. Every child, even the newly born, should be vaccinated if small-pox is prevalent. The younger the child the greater is its chance of taking the disease.

5. Every child should be vaccinated before it is five months old whether small-pox is epidemic or not.

6. If for any reason it is suspected that a person is about to develop small-pox, that person should be vaccinated at once. By doing so the disease may be averted, or what might otherwise have been a bad attack may turn out a comparatively mild one. It is well known that vaccination will overtake and destroy the small-pox infection even when the small-pox infection has had a start of two or three days. After all, however, small-pox may appear if the vaccination is done too late.

7. If small-pox breaks out in a house all the other members of the family should be immediately vaccinated.

It has been already mentioned that cows suffer from a disease called "cow-pox." This disease resembles small-pox in the human subject in so far as it passes through similar stages. There are, however, few if any of the grave symptoms which attend human small-pox. The disease in the cow can only produce pocks when the lymph is applied directly, whereas it is well-known that small-pox may be contracted at a great distance through the air or infected articles of clothing, etc. It is to cow-pox, as has already been stated, that we are indebted for lymph suitable for human purposes. This lymph is of two kinds, viz., "bovine," or the so-called "calf-lymph," and humanised lymph.

Calf lymph is the virus of cow-pox which has passed through a successive series of calves becoming thus more fit for human use.

Humanised lymph is that which is taken from a human being, as in arm-to-arm vaccination. The original supply,

however, was calf-lymph, the supply having been kept up in the human subject instead of the calf. This constitutes the difference between the two.

Lanoline lymph or lymph preserved in lanoline has of recent years been introduced into India and from careful experiments conducted in the Animal Vaccination Depôt at Darjeeling has been found to be a most successful method of storage and preservation, and when carefully used proves most successful in vaccination operations.

Vaccination direct from the calf, however, is the most suitable method from every point of view. The system of vaccination direct from the calf is to be worked in the following manner as described by Major Dyson in his report on the working of the Vaccination Department in Bengal during the three years 1890-91, 1891-92, 1892-93:

"A calf is to be procured through the village headman (as a rule for nothing, though eight annas to one rupee per calf may sometimes have to be paid) and is inoculated with lanoline lymph obtained from one of the depôts, on its abdomen, which must of course be first washed with soap and water and then shaved by the vaccinator. From this calf all the village children are vaccinated, as well as a calf from each of the neighbouring villages, which are brought in for the purpose and returned to their owners immediately after inoculation. When the lymph is ripe on these calves, which is usually on the sixth day after inoculation, the vaccinators proceed to the village and vaccinate from the calves all the children of those villages, as well as fresh calves from other villages. In this way animal vaccination is spread throughout the district, and the evils of arm-to-arm vaccination are avoided. No harm is done to the calf, which requires no particular care during the period the lymph is ripening on it."

In Bengal in 1892 there were 3844 deaths from small-

pox amongst children under one year of age, or 17·18 per cent. of all the deaths from small-pox during that year.

In the same year there were 6273 deaths amongst children from one to six years, or 31·18 per cent. of all the deaths from small-pox, and 3937 amongst children from six to twelve years, or 17·60 per cent. of all the deaths from small-pox.

The total number of deaths at all ages from small-pox during the year 1892 was 22,359. Therefore 15,000 children under twelve years of age died from small-pox whose lives might have been saved if they had been properly protected against that disease by vaccination.

For the purpose of showing the value of vaccination I have made use of two tables from the report of the Sanitary Commissioner for Bengal on vaccination for the three years 1890-91, 1891-92, 1892-93.

In Darjeeling 7357 children under a year were available for vaccination. The number successfully vaccinated was 4008.

In Puri (Jagannath) 29,691 children under one year were available for vaccination. The number successfully vaccinated was 185.

During the year 1892-93 Darjeeling returned 18 deaths from small-pox, or ·08 per 1000 of the population.

During the same year Puri returned 2221 deaths from small-pox, or 2·42 per 1000 of the population.

In 1887-88 Sheffield in England suffered from an epidemic of small-pox. The following statement shows what happened:

CHILDREN UNDER 10 YEARS OF AGE.

	Attack rate per 1000.	Death rate per 1000.
Vaccinated, - -	5	·09
Unvaccinated, - -	101	44

PERSONS OVER TEN YEARS OF AGE.

	Attack rate per 1000.	Death rate per 1000.
Vaccinated twice, -	3	·08
Vaccinated once, -	19	1
Unvaccinated, - -	94	51

These figures show what holds good both in Sheffield in England and Puri District in India, that where the greatest opposition to vaccination exists there exists also the largest death rate from small-pox.

Development of the Pock.—On the second or third day after vaccination a slight elevation can be felt with the finger, and on close examination half a dozen or so small vesicles may be seen, which gradually run together forming one single large vesicle, which bulges round its edges and becomes depressed in its centre. At the same time a red ring is seen round the pock, called the "areola." These constitute a typical vaccine vesicle. During the development of the pock there is usually slight fever, restlessness, and itching. Care should be taken that the pock is not injured, and healing will take place all the more speedily. After the 8th day the contents of the vesicle begin to lose their clean and translucent appearance and turn turbid owing to the formation of pus inside. A crust begins to form near the centre of the pock, and gradually spreads till the whole of it is converted into a scab, which depending upon the care taken falls off from the 15th to the 35th day. When the crust falls off a reddish depressed scar is seen, which gradually turns paler. This scar is the true characteristic of a successful vaccination, and as a rule remains permanent. The consideration of vaccination cannot be more aptly concluded than by quoting the words of a distinguished writer, who says regarding small-pox:

"The loftiest end to be reached is its complete removal

from all civilised countries, and indeed from the face of the earth by universal vaccination and revaccination. The day is not far distant when the man, woman, and child unprotected by vaccination will properly be regarded as an enemy of the human race and treated accordingly. Evidence of the most satisfactory character as to successful vaccination should be imperatively required of all applicants for admission to schools, academies, colleges, charitable institutions, public libraries, art galleries, and places of labour legislatures, political, religious, and deliberative bodies; of every purchaser of a ticket for purpose of travel; and of every voter. In addition there should be in every district a systematic and periodical inspection of all persons registered in the census by persons qualified and competent to perform compulsory vaccination. This is the scientific treatment of small-pox."

CHOLERA.

The germs of cholera, as has been already stated, find their way into our bodies chiefly through water, and milk to which water has been added. The period of incubation is from a few hours to three days.

Symptoms of the Disease. When the germs are swallowed, they grow and multiply rapidly in the stomach and bowels. Great sickness and vomiting occur, and copious discharges of fluid, like rice water, escape from the bowels. Cramps occur in the belly and legs. The skin becomes cold, the pulse weak, and the patient soon begins to look lifeless. The disease often attacks whole families and villages. Out of every 100 persons attacked with cholera, no less than 60 to 80 or even more die.

How to prevent Cholera. The best way to prevent cholera is by drinking none but pure water and pure

milk, and eating none but clean food. We should be cleanly in our persons and habits. People attending cholera patients should be careful to wash and disinfect their hands before eating or drinking, otherwise they will run the risk of catching the disease themselves. The vomited matter and the discharges from the bowels of the sick should be destroyed by burning, or mixed with a disinfectant immediately they escape from the body, carried to a safe distance, and buried deep in the ground, but never near any source of water supply.

Anti-Cholera Inoculation. Anti-cholera inoculation is a new form of preventive treatment which has done good. The effect of the operation does not last so long as that of vaccination. The small operation consists of putting a hollow needle into the skin above the hip. A small quantity of a specially-prepared fluid serum is forced through the needle under the skin. The person thus inoculated may get a little fever and slight headache after the operation, but gets well in a few hours. We should get ourselves inoculated during outbreaks of cholera.

Treatment of Cholera. Treatment is always attended with the best results in the first stage of the disease. The patient should be kept warm. As the germs of the disease do not grow in acid solutions, 10 or 15 drops of dilute aromatic sulphuric acid, hydrochloric acid, acetic acid, or even a little vinegar or lime juice should be given. In the first stage of the illness, one drop of laudanum may be given to a child one year old, and one drop for every year of the patient up to twenty or thirty drops may be given to grown-up persons. In the latter stages of the disease opium should never be given. On the other hand, the patient should be stimulated and kept warm. The legs should be rubbed if cramps are present. Ice

may be sucked in liberal quantity. and small quantities of milk, conjee, or rice water should be given at short intervals.

MALARIAL FEVER.

This is one of the most common fevers in India, and accounts for a very great deal of ill-health, poverty, and distress. No fewer than 4,126,384 deaths from fevers, no doubt chiefly of malarial origin, occurred among the general population of India during the year 1899. The disease is caused by a small living animal parasite which is found in the blood. The disease prevails chiefly in places where the water supply is bad and the soil water-logged, and it is believed by some that the parasite may be conveyed into the system through water. Mosquitoes of a particular kind, called "anopheles," are, however, known to be the chief mode of spreading the disease from one person to another. The period of incubation is fixed at from 3 to 12 days. The attack may, however, come on at once.

Symptoms of the Disease. Malarial fever has a hot, a cold, and a sweating stage. The patient feels very well after an attack is over. If nothing is done to cure it, however, repeated attacks will occur. The blood is soon destroyed, the spleen enlarges, and the patient becomes pale and ill-looking, and may remain in poor health for years, and ultimately die either from the disease itself or something else brought on by it, such as dysentery or some affection of the liver.

How to prevent Malarial Fever. All hollows should be filled up to prevent water from lodging in them and thus forming breeding places for mosquitoes. For the same reason all old tin cans, earthen pots, or other recep-

tacles should not be allowed to lie about houses. Water should not be kept standing too long in bath-rooms or elsewhere in or near human dwellings. Kerosine oil kills the larvae of mosquitoes when poured on the surface of water. It may be used when dealing with tanks. We should get rid of mosquitoes or sleep inside curtains to keep them from biting us More especially, it is desirable that we should protect ourselves at night, as the mosquitoes whose bites bring on attacks of malarial fever are most active at night time. Persons suffering from malarial fever should be kept separate. Captain Birdwood, of the Indian Medical Service, suggests the following further measures, viz., the prohibition of digging and excavating of earth or ponds, the prevention of brick or tile making close to towns and villages, the use of masonry drains, and that all canals and irrigation channels within municipal limits should be lined with cement, the use of gauze windows and doors, and the more general use of quinine.

Treatment of Malarial Fever. If the disease is already in the system, the best way to keep off attacks is by taking quinine. This medicine can be bought at any Post Office in India, in five-grain pice packets. During the year 1899 no less than 3,337,236 of these five-grain packets were sold in Bengal alone. An adult may take as much as four or five grains every four hours, or even larger doses at longer intervals, and young children one or two grains three times daily. There can be no doubt that of all remedies for malarial fever quinine has been proved to be the most valuable.

PLAGUE.

The germs of plague are supposed to get into the system through the skin by direct contact, through the lungs, by

contact with infected clothing, or through living in an infected house. It is believed that the disease is conveyed from place to place by dogs, cats, rats, mice, ants, flies, bugs, fleas, and lice. It is also believed that the germs can be conveyed by clothes, grain, and other food supplies, such as ghee, oil, jaggery, milk, butter, curds, cocoanuts, dates, etc., infected by rats or other animals, and through the air. It is very important, therefore, during epidemics of plague to expose grain, etc., to sunlight, which kills the germs of the disease. The dangers of old rags are supposed to lie in the fleas carried about in them. It is still uncertain, however, how far bugs and fleas account for the spread of plague. Cattle, horses, and fowls do not, it is supposed, suffer from the disease. Monkeys and squirrels do. The sputum, vomited matter, and discharges of patients may also spread the disease. Eating with unclean hands and drinking out of vessels used by the sick have been known to cause the disease. The saliva, it is said, may harbour plague germs for weeks after convalescence. The period of incubation in this disease is from two to seven days.

Symptoms of Plague. Three days are said to be the most common interval between the time of exposure to the disease and the appearance of the symptoms. Ten days are perhaps the longest interval. The symptoms appear suddenly. Shivering, high fever, quick pulse, quick breathing, intense headache, red eyes, vomiting, and great weakness are the chief symptoms. There may also be coughing, and the patient may be unable to sleep. Swelling of the glands are common in the armpit, front of the elbow, groins, neck, and other parts of the body. These swellings are very hard and painful, and the patient resists any attempt to examine them. The patient may be noisy, but as a rule is dull and takes no interest in what is going on

around him. Death may take place within two days after the symptoms appear.

How to prevent Plague. Professor Haffkine has said that if an actually first case of plague is discovered in a big population it is almost as easy to arrest its development as to put out a burning match, but that it is hopeless to check it after the disease has spread. Professor Haffkine was shown some houses in Bombay in which there were 700 to 1000 people living where cases of plague were occurring daily all over the ward. He came to the conclusion that something more than the burning of sulphur in the streets and other measures were required to arrest the growth of the disease in the city. In view of the success of vaccination in preventing small-pox, Professor Haffkine began to work out a means of preventing people from being attacked with plague. As the result of his labours he was able to prepare a serum which he found had this effect, and first tried the effect of it on rats, which catch plague readily. He says, "Take twenty healthy rats got from a ship, which has come from a port where there is no plague. Inoculate ten of these rats with the serum and leave the other ten alone. Put the twenty rats all together and put a rat suffering from plague among them. It will be found through course of time that eight or nine or all the rats that have not been inoculated will die of plague, and only one or none of the inoculated rats will die." Professor Haffkine, after careful observations on rats, began to inoculate human beings. European and Indian gentlemen alike offered themselves to be inoculated to prove the harmlessness of the operation, which is done in the same way as inoculation against cholera. Major Bannerman, of the Indian Medical Service, Superintendent of the Plague Research Laboratory, Bombay, in a report dealing with the value of inoculation in preventing plague, based on care-

ful and reliable tests made during the epidemics between the years 1897 and 1900, arrives at the following conclusions, viz.:

(a) That inoculation is harmless;

(b) That when given before signs of plague are apparent t has in many cases at least the power of averting the disease;

(c) That inoculation confers a high degree of immunity from plague, and so reduces very greatly the number of attacks, and that when, in spite of inoculation, a person is attacked, his chances of recovery are very greatly increased. Professor Haffkine's serum therefore promises well, and evidence as to its real value as a preventive of plague is daily accumulating.

Treatment of Plague. No kind of treatment seems to be of much value. The patient should be kept lying down. Patients suffering from plague can be best treated in hospitals, where they receive good medical attendance and kind, skilful, and careful nursing. The chances of other members of the family and of people living in the neighbourhood catching the disease are thus greatly lessened. Moreover, removal to a hospital is one of the best ways of keeping the disease from spreading generally. The fear of hospitals and concealment of cases have been the chief causes of the spread of plague in India.

DYSENTERY.

This disease is caused by a vegetable parasite, which is to be found chiefly in the bowel discharges. The parasites have also been found in the walls of the bowel, the sputum of the patient, and in liver and lung abscesses. The disease is very common in India amongst both Indians and Euro-

peans, and particularly in jails and other places where many people live together and where there is insufficient ventilation. Changes of temperature, chills, bad food, badly cooked food, raw vegetables, bad air, bad water, all predispose to attacks of the disease.

Symptoms of Dysentery. The lower bowel in dysentery becomes ulcerated. The ulcers may be very small in mild cases or very large in severe cases. There is always griping and pain, which are sometimes very great. The discharges from the bowel, consisting chiefly of slime and blood, may be passed several times in an hour in bad cases. These discharges are so dangerous, that in jails and elsewhere it is the rule to have them burned. Patients after recovery very often remain in poor health. Dysentery is one of the most common causes of abscess of the liver.

Prevention of Dysentery. The only way to avoid an attack of this disease is to be careful about what we eat and drink, avoid chills, and have plenty of fresh air.

Treatment of Dysentery. Complete rest in bed is necessary A dose of castor oil and laudanum is a safe medicine to take in the first stage of the disease. Ipecacuanha is also a valuable medicine to use. Milk food should alone be taken. Hot moist applications to the belly are very soothing. Careful medical treatment and good nursing are often needed. If a case of dysentery is treated in its early stage with repeated doses of saline purgative, such as Epsom salts, beginning with one half ounce in water, and giving teaspoonful doses every two hours afterwards until the bowels are very freely opened, the disease in most cases will be cut short.

ENTERIC FEVER.

This disease, like cholera, is caused chiefly by polluted milk and water. It is believed that it can also be caused by bad gas from foul drains. Attendants on the sick may contract this disease also through soiled hands. Enteric fever, until recently, was supposed to be a disease of rare occurrence amongst natives of India. Captain Rogers, I.M.S., has, however, lately shown that it is very common amongst them in Calcutta Europeans are often attacked soon after they arrive in India. It is common amongst soldiers. The germs are found chiefly in the discharges from the bowels. They are also, however, found in the urine during convalescence. If any of these discharges are thrown carelessly about anywhere, they dry up, get blown about by the wind, and often find their way into our water and milk supply. The germs, it is said, may remain in an active state in the form of dust for a long time. The discharges may also find their way into wells and tanks by soaking into the ground. Water thus polluted, if used for washing milk vessels, or added to milk, will spread the disease. It is very important that all discharges from the bowels should be destroyed or disinfected at once, as in cases of cholera. Great care should also be taken to keep the bedding and clothes of the patient thoroughly clean.

Symptoms of Enteric Fever. This disease has a long period of incubation (10 to 15 days), and the patient may be ill all this time and yet able to walk about. Enteric fever is a disease in which the small bowel has numerous ulcers. Frequent and loose discharges from the bowel, very like pea-soup in colour and consistency, are a common symptom. The bowel becomes exceedingly thin owing to the ulcers eating into it. The ulceration also

causes bleeding at times, and not infrequently the ulcers eat completely through the walls of the bowel, and in this way cause the sudden death of the patient.

Prevention of Enteric Fever. This is a disease in which inoculation as a preventive measure has also been tried with good results so far. Here again, however, good drinking water, good milk, and good food are the best means of prevention.

Treatment of Enteric Fever. The patient should be kept lying in bed until all danger from bleeding or risk of perforation of the bowel has disappeared. In no kind of disease is careful medical attendance and nursing more needed. If the greatest care is not taken when the patient is beginning to get well, a second or even third attack may occur.

HYDROPHOBIA.

This disease is very common amongst both Europeans and Indians. It is caused by the bite of animals suffering from a disease called rabies. The saliva of such animals is sufficient to cause the disease if it comes in contact with a sore or abrasion of the skin of the hand or other part of the body. The bites of rabid dogs are the most common cause. Foxes, wolves, jackals, cats, and even cows and horses may suffer from rabies. Animals affected with this disease are said to be mad. The madness may be of either a raving or a dumb kind.

Symptoms of Raving Madness in Dogs. The dogs are at first quiet, full of fear and do not care to move about. They soon afterwards become ill-natured and refuse to eat their food, but will chew pieces of wood, cloth, mud, or anything else they may find lying about, and in this stage are apt to run wildly about snapping at anything or anybody they happen to meet.

Symptoms of Dumb Madness in Dogs. In this form of madness the chief symptoms are the early loss of power of the hind legs and lower jaws. The animal cannot swallow, and soon dies.

Symptoms of Hydrophobia in Human Beings. The period of incubation in this disease is longer sometimes than in any other known form of disease. Symptoms may not appear for many months after the bite. The first symptoms are very often discomfort and pain in the place where the patient was bitten. The first symptoms, however, may be loss of spirits and sleeplessness. The appetite may also be lost. There is a choking feeling in the throat, and the patient may not be able to swallow even water without bringing on spasms. Breathing is difficult. The patient has a scared look. The saliva which collects in the mouth is spit anywhere, and even into the faces of the attendants. The patient becomes very noisy, and soon dies from exhaustion. The attack seldom lasts longer than from two to four days. Recovery seldom takes place.

Treatment of Bites of Rabid Animals. Animals supposed to be mad which have bitten anybody should not be killed. They should be kept tied up to see whether they are really mad. Caustic or a hot iron wire should be freely applied to the wound. If the animal is mad, the patient should go at once to the Pasteur Institute for what is called the anti-rabic form of treatment. The results of this treatment at the Pasteur Institute in Paris, in 1899, show a death-rate of 0·25 per cent, or 1 death in every 400 persons treated. The death-rate among those bitten by rabid animals, and who have not undergone treatment, varies according to the class of the animal. Some authorities give the death-rate among those bitten by rabid dogs as 30 to 35 per cent., others 50 to 55

per cent., or higher, or a mean death-rate of 42 per cent., that is 168 in every 400 persons. Amongst those bitten by wolves and jackals the death-rate is about 80 per cent., or 320 in every 400 persons. There is at Kasauli an Institute to which persons who are bitten by rabid dogs or other animals may go for treatment, and I would strongly advise any person who may be bitten to go there at once.

The following directions for those who wish to go have been drawn up by Colonel Bamber, of the Indian Medical Service :—*Place where the Institute is Located.*—Kasauli, a hill station 9 miles from Kalka Railway Station. Kalka is 38 miles from Umballa by railway. *Conveyance.*—Dandies and horses. *Situation of Hospital.*—Manor house. *Treatment.*—Free to all classes of people. *Nature of Treatment.*—Hypodermic inoculation, causing little or no pain, merely the prick of the needle. No confinement to bed or quarters during the entire course of the treatment. *Period of treatment.* Fortnight to three weeks. *Attendance.*—Daily at 10.30 A.M. *Accommodation.* Persons bitten by rabid animals are treated as outdoor patients. Lodgings for Europeans and Eurasians, dak bungalow and hotels; for Indians, serai and private lodging houses in bazar.

It is understood that a philanthropic Indian gentleman has recently given funds for providing free accommodation for sixteen poor Native patients, while a Parsi gentleman provides blankets and clothing during the cold weather, and food if necessary. It is particularly requested that patients should avail themselves of the treatment without any loss of time, as the sooner they place themselves under treatment the greater are the chances of their immunity from hydrophobia. 321 cases of bites were treated between 9th August, 1900, and the end of the following year. Of the animals which inflicted the bites 282 were dogs, 27

jackals, 6 wolves, 3 foxes, and horses, mules and cats one each. Jackal bites are reported to have been most severe, requiring special care, as the virus in even slight wounds caused by jackals is very strong. Major Semple, R.A.M.C., the medical officer in charge, remarks in his report that many of the native patients arrive with the idea that they are coming to a hospital, and that they have got to remain in bed during the whole course of treatment; they seem agreeably surprised on learning that this is not the case, and that they can go about as usual.

How to prevent the Spread of Contagious and Infectious Diseases. The chief means whereby this object may be effected are: (1) notification, (2) isolation, (3) segregation, and (4) disinfection.

Notification of all cases of infectious disease should be insisted upon everywhere. This would enable the Health Authorities to take steps to prevent outbreaks of disease assuming serious dimensions. In every instance where suitable accommodation is not available for treating infectious cases in private houses, the patient should be removed to a hospital specially set apart for the reception and treatment of such cases. This is called **isolation.** It would be far better in the interests of the patient, friends, and other people, if all such cases were treated in hospital, and they are very ill-advised who raise objections.

It is sometimes considered desirable not only to remove the sick, but also to prevent those who have been in contact with the sick from mixing with other people until it is certain that the risk of infection is over. Special camps are sometimes provided for this purpose. This is known as **segregation.**

DISINFECTION.

Disinfection has been defined as the destruction of the most stable known infective matter, that is to say the disinfection of the germs of disease and their spores. The agents employed for effecting this are known as disinfectants. Some chemical agents merely restrain the growth of disease germs, but do not destroy them. These are called antiseptics, of which borax and boracic acid, used for preserving food stuffs, and lime are examples. Others simply conceal smells, and are known as deodorants. Charcoal and camphor are used for this purpose in urinals. Tar is largely used for the walls and wood-work of latrines and receptacles for refuse. Condy's fluid and eucalyptus are largely used in European families. Disinfection may be carried out in three different ways: 1st, by fumigation; 2nd, by the use of chemicals; 3rd, by heat.

Fumigation. Fumigation with sulphur is a method which is well known everywhere, and is still very largely employed in India. The use of sulphur fumes has, however, been shown to be a mere farce. The only real good obtained is when the doors and windows are opened after fumigation to admit fresh air Chlorine gas and carbolic acid vapour have also been used. It may be said, however, of fumigation in general that it is of little use.

Chemical Disinfectants. The best disinfectants, and those most commonly used, are carbolic acid and corrosive sublimate. Calvert's carbolic powder, Macdougall's powder, Jeye's phenyle, and Lawe's disinfectants are useful forms of chemical disinfectants. The latter may be used in the liquid form, in the form of soap, or as a powder. It has been extensively used in cases of sickness for washing, for cleaning floors, for latrines, urinals, and numerous other purposes.

Heat. This is the best disinfectant of all. The forms in which heat has been employed are by the direct use of the flame, by boiling, by the use of dry gas or vapour generated in a disinfecting chamber or stove, by steam vapour and steam, and by means of saturated steam confined under pressure in stoves. Hot air is objectionable, on the ground that the temperature necessary to destroy the germs of disease is so great that the articles to be disinfected would in most cases be destroyed. Leather and india-rubber goods are destroyed when exposed to great heat in any form. Prolonged boiling destroys almost all germs of infectious disease. For all practical purposes boiling is a safe and simple means of disinfection for ordinary household use. Boiling is also largely used for sterilising water and milk, and instruments used for performing surgical operations. For the disinfection of rooms the use of what are called Equifex sprayers is to be recommended. These are small hand pumps into which the disinfecting liquid is poured. By working the handle the fluid is forced out of the pump in the form of a fine spray. For disinfection on a large scale, however, such as, for example, the bedding and clothing of a patient or the crew of a ship, special arrangements are necessary; and, as these are very expensive, they have to be provided by the Health Authorities. Large steam disinfectors are used, of which the "Equifex Stove" is the best. The articles to be disinfected are put into a large wire cage, the door of the stove is shut and firmly fixed by means of screws, steam under pressure, in order to get the greatest heat possible, is then admitted. After the expiration of half an hour, or less time ever, the articles thus treated may be safely removed and used again. Every large city and town should be provided with Equifex stoves for public use.

The following instructions, based chiefly on suggestions

contained in Parkes' *Hygiene*, regarding disinfection may be found useful in dealing with cases of infectious and contagious disease."

I. DISINFECTION OF EXCRETA AND DISCHARGES.

The following solutions have been recommended:

A. Carbolic acid solution (1 in 20), *i.e.* 1 part of acid in every 20 parts of water.

B. Mercuric chloride solution (1 in 1000).

FORMULA GENERALLY USED.

Bichloride of mercury, - - - -	½ oz.
Hydrochloric acid, - - - - - -	1 oz.
Commercial analine blue, - - - -	5 grains
Water, - - - - - - - - -	3 gallons

N.B.—This solution corrodes metals and is poisonous.

C. Izal solution (1 in 20).

D. Lawe's fluid (5 in 100).

Either of these solutions should be applied to the vomited matter or excreta immediately they are expelled; they should then be collected and mixed with an equal quantity of the disinfecting solution, allowed to stand for a quarter of an hour, and then be burnt or buried.

Dry earth, charcoal, quick-lime, chloride of lime, and carbolic acid powder are useful deodorisers.

Quick lime, 5 parts, and carbolic acid, 1 part, make a good deodorising mixture.

II. DISINFECTION OF CLOTHING AND BEDDING.

1. Burning is best, and all articles of little value should be burnt.

2. Boiling, or at least soaking, of infected clothing and bedding for 24 hours in some disinfecting liquid, such as one of the following, is useful:

(*a*) Izal, 5 parts to 100 water.

(*b*) Chloride of lime, 2 ounces to 1 gallon of water.
(*c*) Carbolic acid, 5 parts to 100 of water.
(*d*) Bichloride of mercury (1 in 1000) solution.
(*e*) Lawe's fluid (2 in 100).

After soaking in any one of those solutions, the clothing should be boiled and thoroughly washed with soap and warm water.

III. DISINFECTION OF ROOMS AND FURNITURE.

Fresh air and sunlight should be freely admitted. All wood-work should be well scrubbed with soft soap and hot water, or washed with a mercuric chloride solution (1 in 5000), chloride of lime (1 in 100), or Lawe's fluid (2 in 100). The walls should be treated similarly. Spraying with a hand pump will suffice (Fig. 35). Bamboo syringes are sometimes used for this purpose.

These disinfectants are also useful for disinfecting drains, latrines, and similar places. In weak solution they may be used for disinfecting the hands and bodies of attendants on the sick and others brought into contact with the infection. The vapour of formic aldehyde has been highly spoken of as a disinfectant for rooms. Any valuable articles of clothing made of silk or other expensive material which would be spoiled by disinfecting them should be spread out and carefully exposed to the sun.

All rooms in which the sick are treated should be kept scrupulously clean and well ventilated. The room should contain as little furniture as possible. Clothes, mats, books, papers, etc., should be removed. Nothing should be taken out till disinfected, and this more especially applies to the discharges from the body. Nurses should always be dressed neatly and cleanly, and should be careful not to eat with infected hands. The spread of disease can also be



Fig. 35.

checked to a large extent by personal cleanliness, avoiding overcrowding, fresh air and light, and the lime-washing of houses inside and outside.

PERSONAL HYGIENE.

Exercise. It is impossible to remain in good health without taking exercise of some kind. Exercise is generally taken with the object of improving the quality and increasing the size and strength of the muscles of our bodies. It does a great deal more than that, however. It helps to keep the other parts of our bodies in a healthy and active state. During exercise the blood passes much more quickly through the lungs than at ordinary times, and more air and consequently more oxygen are inhaled and more carbonic acid gas is given off. There is also a large increase in the amount of watery vapour exhaled. In ordinary breathing 480 cubic inches of air are taken into the lungs per minute. During walking at the rate of four miles per hour 2400 cubic inches of air are inhaled per minute, while at the rate of six miles per hour the amount inhaled is 3360 cubic inches. During exercise the lungs and chest walls should be perfectly free in their movements. Difficult breathing and sighing while taking exercise point to the fact that there is too much blood in the lungs, and that rest is needed (Parkes). During exercise there is an increased flow of sweat, which also contains waste matter in large quantities. More work is imposed on the heart, which becomes stronger and thicker when used properly. The blood is purified, the appetite improves, and food is more easily digested. Exercise also helps to keep up the heat of the body. Our brains, moreover, work better if we take physical exercise regularly. Exercise is particularly necessary in India, where the heat tends to make people lazy and inactive. Persons who travel about in palkies and other conveyances and take no exercise and who eat a great deal, and more especially such food as fat and sugar, generally become, as has already been stated, very stout.

The forms of exercise are numerous. We should all select that form which suits us best, whether it be riding, gymnastics, bicycling, walking, cricket, tennis, badminton, football, hockey, golf, rowing and boating, or the use of dumbells, or wrestling. Many of these forms of exercise are well known and much liked by the natives of India. The exercises taken should vary to some extent, so that no part of our bodies will suffer from neglect.

It is supposed that a walk of nine miles daily is sufficient exercise for a man whose duties during the day are of a sedentary nature (Parkes). If our labours are of a physical kind, our spare time should be spent in harmless amusements and improving our minds. It often happens that young persons become too fond of games and other amusements, and neglect their studies, and grow up with big bodies, but little mental culture. In trying to develop our strength and our bodies, our brains should not be entirely neglected. "It is the mind that makes the man."

Rules as to Exercise. Excessive or badly-regulated exercise causes too much pressure in the blood-vessels in the lungs, and bleeding sometimes takes place from this cause. Heart disease is often caused in the same way. Too little exercise, on the other hand, also does harm, and may even bring about a condition of the lungs which makes them more liable to be attacked by diseases, such as consumption and bronchitis. Fatty food is of great benefit to those who take much exercise. Spirits are injurious. Water is the best liquid to take, and should be taken, during hard exercise, in small quantities at short intervals, instead of in large quantities after exercise is finished. It is best to take exercise in the open air, because as much oxygen as possible is required to purify the blood, which during exercise contains a very much larger amount of carbonic acid gas than during rest.

Rest and Sleep. Rest of body and mind is as much needed as exercise for the maintenance of good health. It is during rest that the repair and the renewal of our tissues take place. Rest is obtained chiefly during the hours of sleep. Sleep has for this reason been called "Nature's sweet restorer." Sleep is most sound and refreshing in rooms which are quiet, dark, well ventilated, and neither too hot nor too cold. Great heat prevents sleep, and prolonged sleeplessness brings on ill-health. It is for this reason that punkahs, electric fans, and other artificial means of producing a feeling of coolness in the air are used in India during hot weather. Hard beds are more healthy to sleep on than soft beds. It is a mistake to lie upon floors. They may be damp, or foul air from the underlying ground may be inhaled. Fever, dysentery, chills, and rheumatism may be caused in this way. There is, more over, great danger of being bitten by snakes or other poisonous animals. The use of raised beds is strongly recommended. In order to enjoy a good night's rest it is important that our bedding should be clean. The clothing which we wear at night should be made of some light woollen material. Linen sheets should be used, and the under covering should be made of the same material. After we get out of bed in the morning our bed clothes and bedding should be well aired and exposed to the sun, and as much air should be admitted to our bed-rooms as possible. During sleep our heads should not be covered. This leads to rebreathing the foul air exhaled from the lungs. It is for this reason also that two persons should not sleep together. Separate beds should be used. Animals should not be allowed to sleep in bed-rooms, as they use up the oxygen of the air, and give off carbonic acid gas. Lamps, candles, and charcoal fires also, as we know, vitiate the air, and should not be kept burning in bed-rooms if it is

possible to do without them. Cooking should always be done in cook-houses, and never in sleeping rooms. Sleeping rooms should contain as little furniture as possible, as furniture takes up air space. Mosquito curtains are extremely useful as a protection against mosquitoes, whose bites disturb sleep, and, as we know, can cause malarial fever. We should not retire to rest on empty stomachs, because even during sleep the heart, lungs, and other organs continue to work, and require to be nourished. A light meal will not only supply the energy to enable our organs to perform their duties during the hours of sleep, but will also assist in inducing sleep. We should not retire to rest immediately after eating a heavy meal. The heart and stomach are both situated on the left side of the body, and close to each other, although separated by the diaphragm, or midriff. A full stomach interferes with the free action of the heart; a person should not therefore go to sleep lying on the left side. It is better for this reason to lie on the right side Palpitation of the heart, which is a common complaint, is often caused by pressure of the stomach on the heart. This happens when the stomach is distended with gas arising from indigestion. In cases of sleeplessness it is best not to struggle to go to sleep. Sleep often comes when least expected, and to struggle to go to sleep often makes the sleepless feeling much worse. The use of drugs to induce sleep should be strictly avoided except under medical advice.

The Amount of Sleep Required. "Infants require 16 hours of sleep every 24 hours, children two years of age require 14 hours.

Children four years of age require 12 hours.
" eight " " 11 "
" twelve " " 10 "

At 16 years of age 9 hours are required. Women need 8

and men 7 to 8 hours of sleep. Old people require more" (Reynolds).

Cleanliness and how to Cleanse the Skin. Warm water and soap are best for this purpose. Soap is used to make the removal of fat easy. Soap which dries up the skin or makes it tender should never be used. Hard water is not good for cleansing purposes. It takes up the fat, and makes the skin dry and harsh. Boiling makes hard water more fit for use. Rain water, which is soft, is the best water to use for bathing. A nail brush, a piece of flannel or a sponge, may be used with advantage. In hot countries, such as India, the whole body should be washed thoroughly once a day at least; and those parts of the body, such as the hands and feet, which are exposed, should be washed several times daily. When special cleansing is desirable, as, for example, before commencing surgical operations, turpentine is of the greatest service. It removes all traces of fat and smell.

Bathing. A cold bath is very refreshing, but we should not remain in it too long. A plunge into cold water and out again is sometimes sufficient, and may be taken even when the skin is hot and perspiring. If the skin begins to glow immediately afterwards it is safe to take cold baths. If, however, shivering occurs, and the tips of the fingers and toes remain blue and cold, they are hurtful. After bathing, the body should be well rubbed and dried with a thick, heavy coarse towel. The habit of walking home from bathing places with wet clothes clinging to the body is attended with great danger to health. When a bath cannot be taken, the body may be rubbed with a towel which has been dipped in cold water, or a sponge may be used. The skin cools after warm baths. A warm bath, or sponging with hot water, is sometimes used to reduce the

heat of the body in fever cases. The warmth brings the blood to the skin, and the air abstracts some of the heat. It is due to this cause that the fever is reduced. Delicate persons, who have not much blood in their bodies, sometimes faint in hot baths owing to the rush of blood to the skin. A warm bath is also very healthful and agreeable when a person feels cold and chilly.

Turkish Baths cause profuse sweating, and are thus a very useful means of helping to clean the skin. Bathing, either in cold or hot water, should not be done after eating a heavy meal. The cold water drives too much blood to the walls of the stomach, while the hot draws the blood away. In both ways the proper digestion of food is interfered with. "Baths may be roughly classified as follows: cold bath, 60° to 70° F.; tepid bath, 85° to 95° F.; warm bath, 96° to 104° F.; hot bath, 104° to 114° F. A warm bath for a child should have a temperature of 96° to 98° F. The water of a cold bath should never have a temperature less than 59° F., that is, about forty degrees lower than the temperature of the healthy human body" (Simmons and Stenhouse).

Effects of Sudden Chilling of the Skin. Sudden cooling of the body, after hard exercise or exposure to great heat, is sometimes very dangerous. It often causes colds, and, owing to the blood being suddenly driven from the skin, inflammation of the lungs, liver, kidney, and other organs often results. Chills, too, often cause diarrhoea. It is to prevent chills that kummerbunds are worn in India.

Nails. Nails are made of the same kind of cells as skin. The cells have merely undergone a process of hardening. The horns of animals are also outgrowths from the skin. Nails are firmly fixed and have roots, just as hairs have roots. Nails strengthen the tips of our fingers and toes, which they also protect to some extent. The finger nails

sometimes fall off owing to the finger tips being used too much. The finger nails also enable us to pick up small objects, and are useful in numerous other ways. Nails should be kept short and neatly trimmed. Knives, or other instruments, should never be used to remove dirt from underneath them. They make matters worse by raising the nail, and causing dirt to collect more easily and in larger amount. Nail brushes should be used instead. It will, however, be unnecessary for grown up people to use even nail brushes if the use of instruments for cleaning their nails in early life is avoided. Toe nails should be cut square. When boots or shoes are worn, they should not be too short or pointed. A badly shaped and badly fitting boot distorts the feet, causes corns, and makes the great toe nails grow into the flesh. This is a very painful affection, which often requires the removal of the nail. In ingrowing toe nails, the removal of a wedge shaped portion of the point of the nails, leaving the corners untouched, helps to remedy the complaint. Thinning the surface of the nail by scraping is also useful. This treatment makes the nail grow where it is cut or scraped, and stops its growth at the corners. A small piece of cotton or rag, placed under the corners of the ingrowing nail, does good. The nails, especially those of the fingers, should always be kept perfectly clean. Nothing is more objectionable or offensive to the eye of an onlooker than an accumulation of dirt under the nails. The dirt may, moreover, be the cause of some of the worst form of diseases

Hair is also an outgrowth from the skin. In cold climates the head should not be washed more than once a week or once a fortnight. Soap and soft warm water should be used. The white of an egg has been recommended for this purpose, because it does not dry up the hair so much as soap does. Some people wash their hair

daily. This is almost unavoidable in hot countries where the skin is so active. It is not, however, altogether a good practice, as it removes the fat, and, in this way, it is said to cause the hair to turn prematurely grey. A good rule is to wash the hair as little as is consistent with cleanliness. It should be combed and brushed several times a day. This helps to remove dirt. The brush should not be too hard, otherwise the hair will be broken. The use of a hard brush also tends to cause "scurf" (Reynolds). The hair is, as a rule, most abundant when heavy and tight coverings for the head are not worn. When possible, it is desirable to keep the head bare. Dirt and neglect breed vermin and lead to disease of the scalp.

Teeth. It is most important that our teeth should be kept in good order. Stomach disorders and bad health generally are often caused through bad teeth, or loss of these most important organs. Our teeth should be kept thoroughly clean by the use of a soft tooth brush, or other similar means, immediately after eating. The mouth should also be carefully washed with some simple mouth wash, which will prevent the germs that cause decay from doing any mischief. Listerine and euthymol form excellent mouth washes. A pale solution of permanganate of potassium in water is also useful for the same purpose. A fine thread drawn between the teeth helps to remove food particles. Bicarbonate of soda is extremely useful for removing fat. The use of toothpicks should be avoided. If, however, it is necessary to use them, toothpicks made of soft quills or soft wood are better than toothpicks made of metal or other hard substance, which break the teeth. Attention to these details will prevent decay and discoloration. If the habit of thoroughly cleaning them with a soft brush or similar means and plain water or simple mouth wash after food is acquired in childhood, the use of carbolic powder, chalk,

camphor, charcoal, or anything of that kind will not be necessary. If, however, in adult life, decay begins to appear, a dentist should be immediately consulted, as nothing is so painful as toothache, and nothing so offensive as the foul gases which escape from bad teeth. Artificial teeth are the best remedy for indigestion and poor health caused by the loss of natural teeth.

CLOTHING.

Clothing is worn to keep the body warm and dry, to protect it against great cold or great heat, and against injury, disease, and dirt. In most parts of India during the greater part of the year the heat is so intense that the majority of the inhabitants wear clothing merely for the sake of decency. Much of the clothing used in most countries serves only the purpose of personal adornment.

Materials used for making Clothing. In cold countries thick warm woollen material is best. In hot countries white cotton is chiefly used. Clothing which does not conduct heat readily, and thus does not allow heat to escape easily from the body, is the warmest. Fur is the best in this respect, but is used only in very cold countries. Wool, silk, cotton, and linen come next. Linen conducts heat quickly, and therefore feels cold. Waterproof material, such as oil skin, tarred cloth, or cloth covered with India-rubber, is the worst of all to use, because it causes excessive perspiration and prevents absorption. When waterproof coverings are worn, they should be well ventilated. Woollen material absorbs sweat, and thus prevents chills caused by evaporation. Cotton does not possess this quality. Woollen material of light weight, light in colour, and porous is the most suitable material for clothes in all climates, especially in countries with great daily and seasonal variations of temperature.

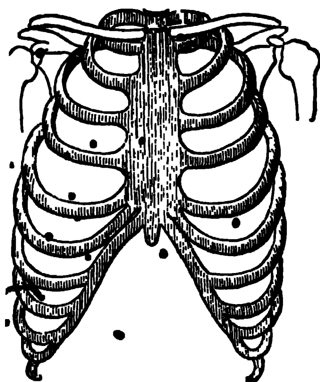


FIG. 36.—NATURAL SKELETON OF CHEST.

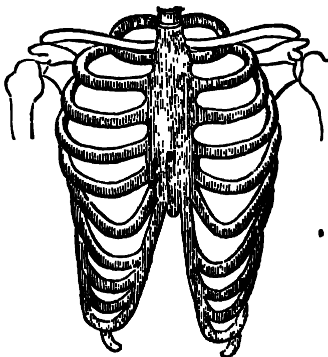


FIG. 37.—SKELETON OF CHEST DISTORTED BY TIGHT LACING.

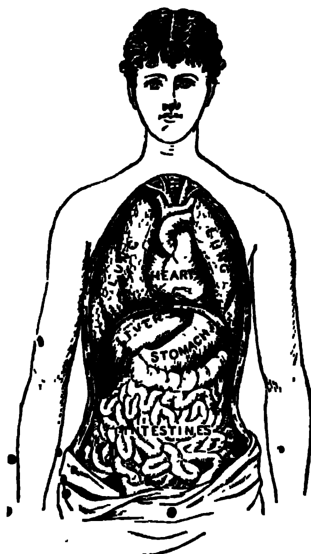


FIG. 38.—THE BODY IN A NATURAL STATE.

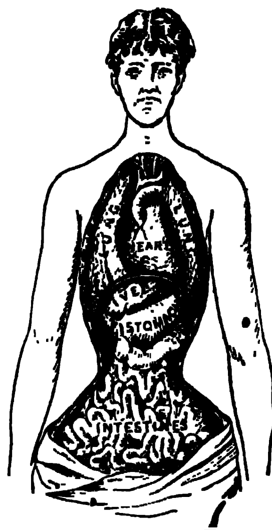


FIG. 39.—COMPRESSION CAUSED BY TIGHT LACING.

The Construction of Clothing. Clothing should be made to fit comfortably. No part of our bodies should be constricted or any of our internal organs pressed upon. Fortunately, amongst the people of India the use of stays and the habit of tight lacing, which compress the organs of the chest and abdomen (Figs. 36, 37, 38, and 39) and are so injurious to the health of European women, are not practised, and boots, which so often distort and cause many painful affections of the feet, are seldom worn (Fig. 40).



FIG. 40.—FOOT DISTORTED BY TIGHT BOOTS, AND NATURAL FOOT.

Dhoties and saries, however, which are worn, should not be drawn too tightly round the waist, and the use of heavy ornaments for the wrist and ankles, which are injurious to health, should be abandoned. Clothing should be suspended from the shoulders, but preferably from a broad band fitting comfortably round the body above the pelvic bones. It should never give too much support to the body, which should be free in all its movements. Supports, such as stays and boots of a particular shape, have sometimes to be used in cases of bodily defects or weakness, or to help to rectify deformities. If possible to do without them,

they should never be used. It is unwise and unsafe to sit in clothes which are damp from either rain or sweat. They should be changed at once. Cloth which has been dyed should not be worn next the skin. Clothing should be porous, to allow of ventilation. Our clothes should be clean, frequently exposed to the sunlight, fit comfortably, and be adapted in thickness of texture to the season of the year. Dirty clothes cause disease of the skin and vermin. Loosely fitting clothing made of cloth of coarse texture is warmer than light clothing of fine texture. During cold weather the use of blankets at night will prevent chills and diseases caused by them. The exposure of infants to cold is extremely dangerous. They should be thickly clad, more especially during cold weather. Attention to the above details regarding clothing will help to keep the body in a strong and healthy condition.

EFFECTS OF EARLY MARRIAGE.

Early marriage, which is the custom among Hindus, is regarded by Dr. Mohendra Lal Sircar, a distinguished member of the medical profession in Calcutta, as the greatest evil of India. In his report for the year 1899, the Sanitary Commissioner with the Government of India observes that no less than 88 per cent. of the total number of women in India between the ages of 15 and 39 were shown at the census of 1891 to be married. It is further observed that 8·4 per cent. of the children born in Calcutta and 18·7 per cent. of those born in Bombay are born dead. The large number of still-births is ascribed to the youthful age of mothers, the unhealthy sanitary conditions in which they live, and the physical labour they are called upon to endure during pregnancy. Marriage should not take place until the body is fully developed, otherwise it is impossible

for the offspring to be strong and healthy or the race to be anything but feeble. Early marriage is, moreover, most injurious to the health of young mothers. Dr. Mohendra Lal Sircar a few years ago remarked at a public meeting: "From medical observation extending over 30 years he could say 25 per cent. of Hindu women died prematurely through early marriage, 25 per cent. more were invalided by the same cause, and the vast majority of the remainder suffered in health from it."

A Bombay Government School Inspector says:

"Hindu and Parsi boys are both sharp and intelligent, and until the age of sixteen few teachers could desire more energetic or painstaking scholars and students. The result of their early marriages and consequent cohabitation is simply deplorable: the great majority of the boys are exhausted and spent before they reach seventeen. Their former energy and youthful brightness are gone. Henceforth, for purposes of close application on the part of the student, they are an utter failure and disappointment." Early marriage is, it will thus be seen, in every respect wrong

THE CARE OF CHILDREN.

The care of children has already been partly considered in connection with the subject of food, clothing, rest exercise, and sleep. The high death-rate amongst children in all countries is due largely to premature births, hereditary tendencies, congenital defects, the want of knowledge as to how children should be fed and clothed, and other matters relating to their proper upbringing, overlaying in bed, to ignorance of disease and how to prevent it, and more especially diseases of an infectious nature, to many of which children are peculiarly liable, as, for example, small-pox, and to insanitary sur-

roundings. In India the youthfulness, immaturity, and inexperience of mothers are also largely responsible. Children, and more especially infants, are very sensitive to cold, and should therefore be kept warm. Their clothing should fit comfortably, and the use of pins should be avoided. Their skins are very tender and easily irritated. The skin and clothing should therefore be kept spotlessly clean. Fresh air and exercise are absolutely essential to good health. Children should be kept in the open air as much as possible. In India it is of course necessary to protect the head against too great exposure to the sun. This observation, however, applies more particularly to European children. The clothing of children should be changed immediately after their play is over, their skin should be well rubbed and dried, and dry clothing should be put on, otherwise they will run the risk of catching a chill. The hours of sleep and the time of going to bed and getting up in the morning should be carefully regulated. This is required of parents, in the case of children attending certain public schools in England, by teachers who fix the hours for children of different ages. Sleeping rooms should be well ventilated, overcrowding avoided, bedding kept clean and exposed daily to sunlight and air. The greatest attention should be given to the food of children, because a great many of their ailments are caused by unsuitable food which they cannot digest.

It is most important that the bowels of children should be kept regular in their action, but the use of medicines for the purpose should be avoided as much as possible. Carefully selected, well prepared, and easily digested food will help considerably to do this. Children should be taught to be cleanly in all their habits. The importance of providing good ventilation for school-

rooms has already been discussed. The subject of lighting should also receive the most careful attention. School-rooms should be so constructed that sunlight may be evenly distributed and glare and shadow avoided as much as possible. Electric light is the best form of artificial light for reading and general use. It should not, however, be allowed to fall directly on the eyes, or injury and defective vision are likely to result therefrom. In this connection attention is directed to the importance of having defects in the eyesight of children attended to directly they are discovered. It is desirable also to be on the outlook for defects of this kind which are often caused through reading books, printed in too small type, or in a bad light. It is also necessary, in cold countries, to provide arrangements in schoolrooms to secure warmth. And lastly, as the health of children often suffers from the constrained position in which they sit at their desks during the hours of study it is considered desirable to give in the form of an appendix what has been said on this important subject by Mr. Priestly Smith and Mr. T. G. Rooper. These rules cannot, perhaps, be applied in the case of children attending many of the small village schools in India where the floor is often their desk, seat, and slate combined. They might, however, be applied with advantage to the health of students in some of the higher schools of learning.

EFFECTS OF EXCESS AND INTEMPERANCE IN THE USE OF TOBACCO, OPIUM, ETC.

Tobacco is the leaf of a plant called *Nicotianum Tabacum.* It is grown very largely in South America, India, and other parts of the world, and is used extensively everywhere. It is, as a rule, smoked. It is, however, occasionally chewed.

Like the chewing of pan, the chewing of tobacco is an exceedingly dirty and unhealthy practice. In India a small quantity of tobacco is often taken with pan, and cocaine is sometimes used in the same way. Tobacco is also used, but less frequently, in the form of snuff. Snuff-taking used to be a fashionable practice.

Composition of Tobacco. Tobacco leaf contains an oily material, and an alkaloid called nicotine. Both these substances produce violent sickness. One drop of the nicotine is sufficient to kill a dog. Tobacco smoke is also used to kill the small insects which infest plants. The amount of nicotine contained in different kinds of tobacco varies considerably. As a rule, not more than four or five drops are contained in one ounce of tobacco, and part of this amount is got rid of when the tobacco is smoked. If this were not so it would be most dangerous to life to use tobacco at all. It is the oil and nicotine of tobacco which give old pipes and the ends of cheroots their bitter taste. When tobacco is smoked, certain other injurious products are given off from it, which have poisonous effects on the system.

How the Poisonous Products of Tobacco get into the System. When tobacco is smoked the products of combustion get into the system through the lungs, the delicate structure of which has already been described. It was also pointed out that the lungs absorb gases greedily. Since we know, as has been stated previously, that the interior of the lungs has an absorbing surface of no less than fourteen hundred square feet, we cannot be surprised at the effects on the system when poisonous gases, such as those contained in tobacco smoke, are inhaled in large quantity. The poisonous substances in tobacco can also be absorbed by the skin when tobacco is applied to it, or through the lining membrane of the mouth, stomach, or nose when it is chewed or taken as snuff. The effect of the poison on the

system is exactly the same, no matter how it finds its way into the blood.

Effects of Tobacco on the System. Smoking in moderation has a soothing effect on persons who are restless, and who are in the habit of using tobacco. It is believed to help digestion, and prevent the waste of body tissue. It puts off hunger. The risk, however, of becoming an inveterate smoker, and the evils resulting from the use of tobacco in excess, are so great that its use even in moderation should never be indulged in. When the habit is acquired it can seldom be broken off, although the health may be considerably undermined by continuing it. Boys who foolishly, and because they think it manly, use tobacco are likely to grow up to be men with weaker intellects and poorer physiques than boys who wisely shun it. When used to excess tobacco not only blackens the teeth and spoils the breath, but acts injuriously on the entire system. Sleeplessness, depression of spirits, headache, unsteady hand, and shaky legs indicate the effects of tobacco on the nervous system. The circulatory system is also affected. There is violent palpitation, the heart beats are irregular, and now and again a beat is lost. The pulse is also quick, irregular, and feeble. Heavy smokers are often pale and unhealthy-looking, owing to the poor quality of their blood. Severe pain is sometimes felt in the region of the heart. Breathlessness in climbing stairs is another well-marked indication of the evil effects of the excessive use of tobacco. The throat is irritated, and a tough, glairy phlegm, which gives rise to constant hawking, accumulates at the back of it. This is known as smokers' sore throat. The appetite is impaired, food cannot be properly digested, and the tongue becomes dry and foul. Tobacco has also an injurious effect on the eyes. The smoke may set up inflammation. After years of excess

the vision often becomes dim, or the sight may be entirely lost, owing to disease of the optic nerve. The evils are intensified when smoking is indulged in in the company of other smokers in a crowded room where the ventilation is bad, and the injurious effect on non-smokers also occupying the same room may be very marked indeed. Professor Fraser, of Edinburgh University, one of whose lectures has been most helpful to the author, in dealing with the subject of tobacco, has recorded the fact that death from smoking has occurred in a novice after only two pipes, and in habitual smokers after seventeen or eighteen pipes were continuously smoked.

Opium. Opium is obtained from the poppy head. In China it is used much more largely than tobacco. In India the opposite is the case. When the habit of using opium is acquired it is almost impossible to break it off, and the evils resulting from its use are vastly greater than those arising from the use of tobacco. The confirmed opium eater soon becomes a complete wreck, mentally and physically. The use of opium in any form should never be resorted to except in cases of sickness in which the medical attendant thinks it necessary. Its use, however, even in such cases, should be stopped as soon as possible, as patients are apt to acquire a craving for the drug, and often continue to use it after they are well, and thus become habitual opium-eaters. Opium in even the smallest quantity should never be given to infants under one year of age.

Indian Hemp (*Cannabis Indica*) is another drug which is largely consumed in India. Ganja, bhang, and subjee are all forms of the drug which are obtained from different parts of the plant, such as the flowers, leaves, and stems. It is usually smoked, but may be eaten or drunk. It is used for many purposes, but chiefly as a stimulant. Its

usefulness has, however, been overstated. It acts chiefly on the brain. Persons under the influence of the drug are often highly excited and quarrelsome, and may even commit murder. The drug is believed to cause insanity in many instances. Its use is unnecessary and harmful, and the habit of using it should therefore never be formed.

Cocaine. Cocaine is an alkaloid obtained from the leaves of the coca tree (*Erythroxylan Coca*).

Major Buchanan, of the Indian Medical Service, has lately called attention to the spread of the habit of cocaine-eating in certain districts in Bengal, more especially among young people, and has pointed out the danger to health arising from its use. The subject has, in fact, come so prominently into notice that heavy fines have been recently imposed upon persons for selling the drug without a license. Pan sellers are said to carry on the trade to a large extent. Like all other habits, that of cocaine eating grows upon its victim; and Major Buchanan has related a case where a boy aged 15, a prisoner in the jail at Alipore, stated that since he had been taught the habit he would gladly run the risk of theft to obtain the drug. Cocaine at first makes the person who uses it feel somewhat the better for its use, and allays the pangs of hunger, but afterwards produces great depression. The blackened teeth, with the white cutting edge, are regarded as a characteristic feature in the cocaine eater. The person becomes a slave to the habit, and the health is undermined. In some cases it produces immediate depression. As in the case of tobacco, when the use of cocaine is given up the consumer begins to put on weight.

The Use of Pan. Pan chewing is common among almost all classes of natives of India, and is, as a rule, begun in early life. No distinct benefit to health can be shown to result from its use; on the other hand, diseases

of the mouth and tongue are often caused by it. The habit, like tobacco chewing, is a very filthy one. The red tongue, the thickly coated teeth, the stained saliva which often trickles from the mouth, and the constant spitting in public thoroughfares, public conveyances, on floors, walls, and elsewhere, make those who indulge in the practice objects of disgust to more cleanly individuals. They are well-advised who avoid its use

In his report for the year 1901, Dr. Stanley, the Health Officer of Shanghai, observes as follows:

"Tuberculosis is rampant in Shanghai. Among the foreign resident population one death in every seven is due to tuberculosis, while among the Chinese it claims a larger number than any other disease. It is, undoubtedly, chiefly spread by the spit of consumptives, and the disgusting habit of the Chinese of profuse expectoration in public places is largely responsible."

In another part of the same report it is remarked:

"There are, probably, at the present time at least 5000 cases of consumption among the Chinese in Shanghai, the majority of whom individually spit out, daily, millions of deadly tubercle bacilli."

This habit of promiscuous spitting is common in every country. The evils of the practice are now, however, generally recognised, and strong efforts are being put forward in some countries to stop it. Notices, for example, are placed in conspicuous places in almost all the tramway cars in New York and San Francisco directing special attention to the fact that, any passenger found spitting in the cars is liable to a fine of 500 dollars or six months' imprisonment, or both. Steps of this kind are much needed in India, and more especially in some of the larger cities and towns, if the staircases, floors, and walls of Magistrates' Courts, Municipal Offices, and other public buildings, are

to be maintained in a cleanly and sanitary condition, to which they make absolutely no pretence at present.

Remarks regarding Habits. "Habits," it has been said, "are soon acquired, but when we try to strip them off, 'tis being flayed alive." It has also been said, "Ill habits gather by unseen degrees, as brooks run rivers, rivers run seas." Do not, therefore, begin bad habits, and you will never experience the terrible difficulty of giving them up. Children who shun the use of alcohol, tobacco, and other injurious drugs, and who abstain from the very appearance of evil in other directions, are likely to grow up with more vigorous minds and bodies than children who fall victims to such habits. They will, moreover, be more useful and more highly respected members of society.

HOUSES.

Before beginning to build a house it is necessary to observe certain precautions.

Choice of a Site. We should first of all select a good site. In many districts in India the rainfall is heavy and rivers often overflow their banks. The houses of the poor, and others who are compelled, by circumstances, to live in such districts, are usually built on sites artificially raised and are surrounded by water during the wet season of the year. Such sites are unhealthy. The site should be dry. High ground from which water readily runs off is best. Gravel, sandy and rocky ground, and sandstone, form good sites. Clay is not good. Water does not pass freely through clay. The water collects above it, and the ground becomes what is called water-logged. Rheumatism, fever, chest affections, and other diseases are common amongst people who live in houses built on clayey sites. Damp

sites should, therefore, be well drained. Ground which is very loose and porous is not quite safe either. There is always the danger of impure matter finding its way through loose soil into wells or other sources of water supply. Water can always be got at a greater or less depth in the ground. If it is found at a distance of less than 10 feet from the surface the site is not a good one. Houses should not be built on "made sites," such, for example, as tanks which have been filled up with street sweepings, scrapings, and stable refuse. Houses should not be built near refuse heaps, trenching grounds, brickfields, graveyards, marshes (jhils), or near mills or factories which give off much smoke, irritating gases, or offensive smells. The danger of made soil is the carbonic acid gas and other foul products which are given off from the decaying animal or vegetable refuse.

Plans. In all large towns and cities the law requires plans to be submitted for the approval of the municipal authorities before people can begin to build houses. If this were not done, houses would be built too closely together, and streets would be too narrow. No open spaces would be left; no provision would be made for the admission of sufficient light and air. Water-closets and latrines would be built in wrong places, and the means of flushing and keeping them clean would not be supplied. There would perhaps be no easy means of access to latrines, or too little space would be left to enable the sweepers to keep them clean. The importance of plans, therefore, is obvious.

The Construction of Houses. The wind throughout a large portion of the plains of India during the hot weather generally blows from the south or south-east during the hot months, and it is for this reason that houses in that part of the country should be built with a southern

aspect. The foundation of houses, floors, walls, roofs, and ceilings should be made of good material, and the houses built on the most modern sanitary principles and strictly in accordance with law. No deviations should be allowed. The entire site should be covered with good masonry to keep out the damp and ground air, and arrangements should be made for keeping the foundations well ventilated and the walls dry. Damp-proof[1] courses should be provided for this purpose. They should be made of hard glazed bricks, but never asphalt, felt, or slate. All houses in India should have a plinth at least one foot high, and a verandah for protection against sun and rain and to avoid glare. Rooms should not be more than twelve feet high, and be well ventilated by means of windows and doors. There should be at least one door for each room. Two windows are enough, and should be opposite each other to secure good ventilation. Provision should be made for the escape of smoke from fires with which it may be necessary to warm the rooms during cold weather. Chimneys are used for this purpose. Each fire-place should have a chimney which has no communication with any of the other chimneys of the house. The rain from the roofs of houses in India either runs down the walls direct or escapes through spouts. As it falls it is often blown against the walls. The walls in consequence become very damp. The use of gutters and pipes leading down the wall, situated at short distances from each other, would prevent this to some extent. All houses should be surrounded by a masonry drain to carry off rain water. This will help to keep the ground dry. The foregoing remarks apply chiefly to masonry houses.

[1] A damp-proof course is a waterproof layer of masonry a little above the level of the ground to keep moisture from rising through the walls.

Huts in Villages. The rules which are observed in the construction of masonry buildings of large and imposing size in large cities and towns should be observed also in the construction of the huts of the most humble individual. They should not be built too closely together. The site should be a good one. The materials should be the best which their means can afford. They should be well lighted and ventilated. Air and light should, if possible, get into all rooms from all sides An outlet for smoke should be provided. There should be a good water supply, suitable latrine accommodation, and the best possible arrangements should be made for the careful and speedy removal and disposal of refuse at a safe distance. The following is an extract from Grant's *Indian Manual of Hygiene* bearing on the subject, and deserves careful attention:

"For the repair and maintenance in a state of comparative cleanliness of the ordinary houses of the natives of this country, the following twelve simple rules should be adhered to:—(1) The use of cow dung as a covering for the floor and walls should be given up; it is *a dirty habit and an unhealthy one*, for cow-dung attracts excess of moisture and forms a *nidus* for microbes. (2) Mud floors should have *the surface dug up and removed every few months*, a layer of fresh mud, to replace the mud taken away, being laid on and beaten in during dry weather. (3) Mud walls should be left in their *natural condition internally or whitewashed* every four months. (4) Every room should have either *two windows about 2 ft. square opposite each other or else one window 3 ft. square opposite the door.* Windows *must open to the outer air.* (5) In the cook room there should be some sort of vertical opening or chimney in the roof to allow of the *ready escape of smoke.* (6) Dirty water and food refuse should on no account be thrown away in the immediate

vicinity of the house, but *carried to a drain or dust-bin respectively and there deposited.* (7) The earth round the dwelling should be *well beaten down and a small channel made leading to the ditch or drain at the side of the road,* for disposing quickly of the rain water as it pours off the roof. (8) The house *should be opened up as much as possible, morning and evening,* to allow of free perflation. (9) Its exterior should be *whitewashed* as often as necessary to keep it cool and clean. (10) The latrine must be *outside* the general building, with an *impermeable floor* of asphalt or cement, if possible, *easily accessible from behind* for the sweeper, *cleaned daily,* and with a door and window large enough to allow of *plenty fresh air and light* gaining admittance. (11) Whilst a few plants and small trees in the neighbourhood of a house are pleasant, there should be *no interference with the free passage of fresh air and light to all parts of the dwelling,* and all animals, such as cows, ponies, fowls, etc., should be *separately housed outside the house and its enclosure.* (12) The occupants of the house should be *limited to the proper number,* and the unhealthy and objectionable practice of letting rooms to various families prohibited."

WASTE AND IMPURITIES.

Refuse may be either solid, or liquid, or a mixture of both. Sewage consists chiefly of the solid and liquid discharges of human beings. It also contains liquid material from stables, cowsheds, and similar places; water with which pots and pans have been cleaned or floors washed, and bath water. Sewage is the refuse which it is most difficult to dispose of, and requires most careful consideration.

Solid Refuse. Solid refuse consists of ashes, dust, the sweepings of houses and streets, waste paper, broken pots, rags, fragments of vegetables, fruits, and other kinds of food, the refuse of markets and slaughter houses, the droppings of animals, stable litter, and other matter of a similar nature. The streets of some large cities in India, such as Calcutta, from which hundreds of tons of refuse are removed daily, always look dirty and neglected owing to the objectionable practice of throwing out refuse at all hours of the day and night. This, and the practice of allowing it to accumulate around dwellings, are fraught with the greatest danger to health. Epidemic diseases, as we already know, are always most severe in dirty places and amongst dirty people.

Liquid Refuse, excluding sewage, consists chiefly of ordinary household refuse water.

The Disposal of Refuse. All refuse, such as food particles, ashes, and sweepings of floors, compounds, and court yards should be put into dust-bins with proper covers, and kept there till the refuse carts or village sweepers come round to remove them. Paper, straw, leaves, and other refuse are sometimes used for filling up tanks. The refuse of stables and cattlesheds, however, should never be used for this purpose. Mineral matter, such as building refuse, is best. Where possible refuse should be burned. In some large towns special furnaces, called incinerators, have been constructed for burning house and street refuse. In villages refuse may be burned in any hollow at a safe distance from houses. When so disposed of, refuse is no longer dangerous to health, because the small germs, which cause disease, grow and multiply most rapidly in those places where refuse on which they feed is to be found. In the city of Glasgow, boys in uniform are employed to collect waste paper. Eighteen tons are

collected weekly, and the municipal authorities make from it a profit of two hundred pounds, or three thousand rupees yearly. The boilers at the three largest stations of the cleansing department are moreover fired, and the machinery is driven solely by the use of cinders thrown out from dwelling-houses, and saved from the collected waste by the scavengers or sweepers. Solid refuse from stables and cattlesheds should not be collected in heaps near dwelling-houses. It is good for the crops, and should be taken to the fields.

DRY SYSTEM OF REMOVAL OF SEWAGE.

In large villages and towns, baskets coated with clay, wooden buckets well tarred, and sometimes iron carts are used for the removal of the solid contents of latrines. All latrines should be provided with suitable receptacles. This will help to keep them clean, make the sweeper's duties easier and less disagreeable, and save time. Earthenware vessels are generally used for this purpose. They should be kept thoroughly clean and well tarred. Broken vessels should never be used. The night-soil may be mixed or covered with ashes, or dry earth, or the sweepings of the house. The use of the chemical substances to mask smell will not be needed if proper attention is paid to cleanliness. As a rule the liquid portion of sewage of villages in India escapes into the ground. This should be prevented as much as possible.

Urine and foul water should be taken to the field or trenching grounds.

The use of cesspools built in the plinth of houses for collecting foul liquids should be forbidden.

Trenching. This is a well-known method of disposing of sewage by burying it in the ground. The trenches

should be large and shallow. Trenches one foot deep and three feet broad should be used, and not more than three inches of night soil put into them. The night soil should then be spread out, and afterwards covered with the earth removed in digging the trench. The earth and the night soil combine with each other, and in a few weeks no smell remains. Deep trenches are very objectionable, and should not be used.

The Cultivation of Trenching Grounds. Trenching grounds are always more or less dangerous to health. The dangers are, however, greatly lessened by cultivation. Unfortunately, the great majority of the natives of India object to the use of anything grown under such conditions. Where this objection has been overcome, and trenching grounds have been brought under cultivation, as in the city of Puri (Jagannath), in Orissa, abundant crops of cabbages, cauliflower, mustard, Indian corn, and other grains are obtained, and a rich reward is reaped, not only in money, but in health. The value of the waste products of human beings and animals for agricultural purposes is beginning to be recognised. The inhabitants of villages know that crops are always most abundant in fields which are used as latrines, and when such fields are put up to auction or leased out, they always fetch a better price than fields which are not so used. It should be understood, however, that the practice of using fields as latrines is exceedingly dangerous, because, as has been pointed out, the discharges from the bowels often contain the germs of some of the most fatal forms of disease. All villages should be provided with well-built latrines, and sweepers should be employed to remove the contents to trenching grounds at a safe distance. There are very many different kinds of latrines in use. Midden pits should never be used. The best and most suitable for small towns and

villages is that known as "Donaldson's latrine," which is made of iron and fairly cheap. This latrine is so constructed that the solid and liquid waste matters are kept separate.

THE DISPOSAL OF SEWAGE OF LARGE TOWNS AND CITIES.

Water Carriage System, or the Wet Method. Large underground drains or sewers are used for getting rid of sewage in large towns and cities. They may be built of bricks, or iron, or earthenware pipes may be used. They are usually round or oval. These sewers often empty themselves into rivers, and sometimes into the sea. The sewage of Calcutta runs into the salt water lake situated several miles away from the town. If possible, the use of outlets of this kind for sewage should be avoided. In order to help the flow of the sewage, and for the purpose of flushing and cleansing the sewers, an unfiltered water supply is provided. If an abundant water supply were not provided, the contents of the sewers would stagnate, decompose, and give off evil-smelling gases. Sewer gas is believed to be the cause of many fatal diseases, and when constantly breathed is often the cause of ill-health amongst children in particular, and also amongst grown-up people. Typhoid fever, diphtheria, ordinary sore throat, and diarrhoea are the most common examples of diseases which, it is believed, may be caused by sewer gas. The sewage from houses finds its way into the sewers through small house pipes, which lead from the water closet or latrine situated inside the house. These house pipes should, therefore, be well made, consist of the best material, and

have a good flow. In order to help the flow of sewage through the house pipes into the sewers, all water closets are provided with large iron tanks, situated near the roof. The water is allowed to flow out of the tank into the water

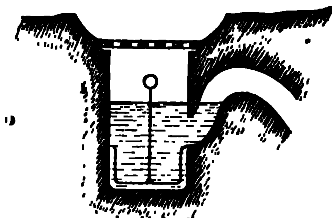


FIG. 41.—GULLY TRAP.

closet pan, which receives the discharges from the body, by pulling a handle or by some other simple means. The water washes out the contents of the pan, keeps it clean,

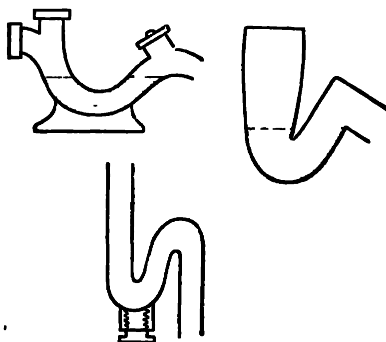


FIG. 42.—VARIOUS FORMS OF SYPHON TRAP.

and helps to flush the house pipes which convey the discharges to the street sewers. At least two gallons of water are required each time the water closet is used. In

order to prevent the escape of gas from the sewers into the house pipes, and from the house pipes into houses, traps are provided. The traps are merely bends in the house pipe or sewers containing water, which helps to keep the gas from passing through. This layer of water is known as a "water seal." It is usual also to have a ventilating pipe attached to house pipes on the outside of the wall of houses extending well above the roof, to allow of the escape of any gas that may by chance find its way back from the sewers.

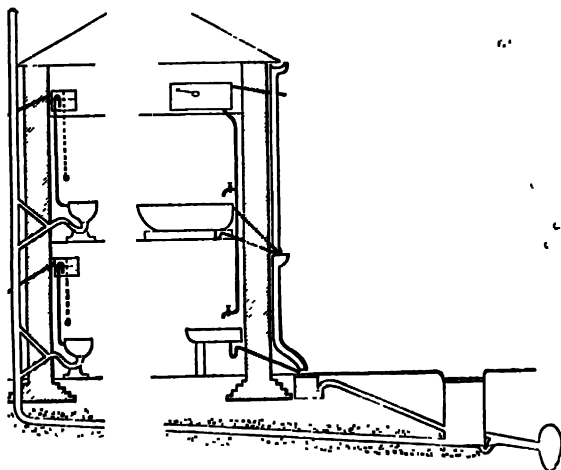


FIG. 43.—HOUSE WITH GOOD SANITARY ARRANGEMENTS.

In the same way the sewers should be ventilated by pipes placed at short distances from each other along the entire length of the sewers. The best traps are those known as the syphon and gully traps (Figs. 41, 42, 43). When the water-carriage system for the disposal of sewage is adopted, the sewers, drains, pipes, gullypits, and everything connected with the system must be made of the

best material, carefully constructed, provided with the best form of trap, and be well ventilated. There must also be a liberal supply of water for flushing and cleansing purposes.

Precipitation of Sewage. The solid and liquid portions of sewage are sometimes separated by the addition of chemical substances. This is called the precipitation of sewage. The solid portion is made into cakes, which are sold as manure or burnt. The liquid portion may be filtered by allowing it to run through cinders with the object of purifying it. It should not be allowed to flow into rivers, or other water channels, the water of which is used for drinking purposes.

Filtration of Sewage. Sewage is sometimes allowed to flow on to land without any attempt to separate the solid and liquid portions as described above. Porous dry land is best suited for the purpose. The land should be well drained. This method is adapted for districts in which the rain fall is scanty. Sewage farms are so called because sewage is used in this way for cultivation on a very large scale.

Septic Tanks. Another method of purifying sewage is what is known as the "septic tank system." The sewage flows into settling tanks and then into large filters containing coke, breeze, or cinders. The liquid after filtration is clear and free from smell, and remains thus for months even when kept in bottles. This method promises well. It is being largely used in England. Mr Silk, the Sanitary Engineer to the Government of Bengal, is carrying out experiments in different parts of the Bengal province which promise well.

Incinerators. In jails and hospitals the night soil of patients suffering from cholera, dysentery, and other diseases of this nature is destroyed by burning. Donald-

son's incinerators are used to effect this object. This is a most excellent method of disposing of night soil, and if it could be adopted on a large scale would be the safest and best of all systems for the disposal of human refuse. This method ought to be tried in small village communities.

Concluding Remarks. No kind of refuse is more dangerous to health than the waste matters from the bodies of human beings. Terrible outbreaks of cholera and enteric fever have often been traced to the pollution of the water supply with the discharges from the bowels of patients suffering from these diseases.

It is most important, therefore, that the greatest care and attention should be given to their speedy removal and disposal. The health of towns and villages will depend largely upon whether or not this rule is followed.

DISPOSAL OF THE DEAD BODIES OF HUMAN BEINGS.

The practice of cremating or burning the bodies of dead persons is, beyond question, the most sanitary. This is the practice amongst Hindus. Christians and Muhammadans, for sentimental reasons, bury their dead. The dangers of this practice are in the foul products given off from the body during its slow decomposition in the grave, which may find their way into wells and other sources of water-supply, and thus cause serious outbreaks of disease. Plants and shrubs, which are sometimes planted in grave-yards, make use of the products of decomposition of the body for their growth, and in this way help to purify the soil. In cremation the same products are given off. They all, however, combine quickly with each other to form compounds of a safer kind, which speedily become diffused throughout the atmosphere. The dangers are thus reduced to a minimum in the quickest

manner possible. This is the great advantage of cremation. The only objection to it is, that if bodies are burned without careful inquiry as to the cause of death, cases of homicidal poisoning may not be detected. There are, however, stronger arguments in its favour. Mummification is only mentioned to be condemned. Burial at sea is also not an uncommon method of disposing of the dead. Whatever method is adopted, the process should be conducted with the greatest care and respect for the dead. Grave-yards should not be allowed to exist near human dwellings, or near any source of water-supply. The soil should be porous and dry. Graves should be not less than five or six feet deep. Coffins made of imperishable materials or masonry graves are objectionable, because they delay decomposition. If coffins must be retained, they should be made of the most perishable materials, light deal, or still better, basket-work, as advocated by the "earth to earth system" (Willoughby). It is a common sight in India to see dogs, jackals, and vultures preying upon dead bodies which have been either left unburied or covered with a few inches of soil, and it is still more common to find human skulls and other bones of the body lying scattered over large extents of land, more especially on the banks of rivers. This state of matters would not be allowed to continue in European countries. The inhabitants of different towns and villages in India should give this subject their most careful attention, and vie with each other in trying to put a stop to the disposal of the dead in such a careless and dangerous manner.

DISPOSAL OF THE CARCASES OF ANIMALS.

Rats, as we know, are one of the chief means of the spread of plague, and are themselves liable to be attacked with the disease. Dead rats should, therefore, not be

touched with the hands. Their bodies should be burned immediately on discovery, after applying kerosine oil to them. The carcases of animals should never be allowed to lie about our streets or houses. In municipal towns dead animals, such as cats and dogs, are removed by domes in carts specially provided for that purpose. Immediate removal and deep burial at a safe distance from human dwellings and water-supply is the proper way to dispose of the carcases of animals in the absence of the means of burning them. In municipal towns persons are fined for not reporting or removing dead animals from their premises within three or four hours after discovery

VITAL STATISTICS.

These consist of figures and other information relating to births, deaths, marriages, the sex and ages of people, diseases and their causes, and trade or occupation and their effect on health. They also deal with the causes of the increase or decrease of population in cities, towns, and villages. The increase of population may be due to births or to the arrival of persons from other places. The decrease may be due to deaths from sickness or famine, or to the departure of persons who cannot find employment or obtain good wages near their own homes to other places where the conditions of labour and wages are said to be better. Natives of India for this reason emigrate to British or other colonies, to Assam, and elsewhere. Many births in a place, and a great increase of its population owing to people coming from other places, indicates prosperity. The population of Calcutta has, for example, increased to the extent of 200,000 during the past ten years. In cases where the number of deaths or decrease in the population is great, inquiries are made to find out the cause. In the

year 1899 the death-rate amongst infants in the Bombay Presidency was 192·7 per 1000 of the population, while in the city of Bombay the death-rate was 798·69 per 1000. On inquiry it was found to be due to plague, scarcity, and the immigration of destitute waifs. When the cause is discovered, steps are taken to prevent further loss of life. When, for example, famine is found to be the cause, famine works are started, and food is given. When small-pox is the cause, vaccination and re-vaccination are the remedies. Cholera is generally caused by polluted water. When the health authorities, therefore, are informed that this disease has appeared in any town or village, immediate attention is directed to purification of the water-supply. Vital statistics further show the result of the measures taken in particular instances of the kind stated, and the steps taken otherwise to improve the health of a community. It will thus be seen how necessary and useful vital statistics are.

Sanitary Inspections and Sanitary Laws. In all civilised countries in the world laws have been passed to prevent people from doing acts which might injuriously affect the health of their neighbours. These are called sanitary laws. If such laws were not passed our food-stuffs would be adulterated to a much greater extent than they are at present; articles of food unfit for use would be sold in our bazaars; the water which we drink would be polluted with human and animal refuse; the air would be poisoned with foul gases; houses would be badly built and over-crowded; and streets would be narrow, dirty, and dark, owing to the absence of sunlight, which is so essential to health. There would be no open spaces left for taking exercise and breathing in pure fresh air; refuse would be allowed to accumulate everywhere; drains and latrines would not be kept clean or in a good state of repair; dead bodies and the carcases of animals would not be properly

disposed of; the practice of throwing them into rivers would become common; nothing would be done to prevent the outbreak of epidemic diseases or check their spread; people suffering from small-pox, cholera, plague, and other diseases of this kind would travel about in palkies, hackney and railway carriages, and other public conveyances; nobody would try to prevent this; nothing would be done to cleanse and disinfect the conveyances afterwards, and other people using them would thus be liable to catch the disease. In short, nuisances of every kind would be committed. When we imagine the terrible consequences which would result if no sanitary laws existed, it is not difficult to understand how important and necessary it is that people should be punished for disobeying them. The object of sanitary inspections is to ascertain how far, if at all, sanitary defects exist, and to enable the health authorities to take the necessary steps for their removal or mitigation. It is the duty of every citizen to assist the health authorities in their efforts to bring about an improved state of the health of communities. They should, for example, get their children vaccinated, and thus help to prevent attacks of small-pox; or inoculated when plague is prevalent. When cases of disease of this nature break out it is their duty to report the occurrence, so that proper steps may be taken by the authorities to keep them from spreading. It is also the duty of citizens to obey the law themselves, and to assist in trying to prevent other people from evading it, and thereby bringing about the sanitary evils mentioned above.

SOME ORDINARY AILMENTS AND ACCIDENTS, AND THEIR TREATMENT.

Parasites. Parasites are of two kinds, namely, animal and vegetable, and are so called because they live and grow

upon or within other animals and vegetables. They have been called also hangers-on. The best and most familiar examples of animal parasites are round worms, thread worms, tape worms, the itch insect, and lice. Ringworm of the body is the best example of a disease which is caused by vegetable parasites.

Round Worms (Fig. 44). Round worms, which closely resemble earth worms in appearance, are very common amongst those who are careless in their habits, and indifferent as to what they eat or drink. They may be a foot in length, and often exist in very large numbers in the human system. They inhabit chiefly the small intestine. They are sometimes vomited, or may escape in the discharges from the bowels. They are supposed to get into the system in drinking water. The disease has been known to prevail in India in almost epidemic form, Europeans and Indians alike suffering.

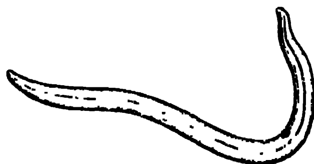


FIG. 44.—THE ROUND WORM.

Round worms may be got rid of by clearing out the bowels as carefully as possible with a dose of castor oil and giving four or five grains of santonin powder early in the morning before taking any food. Children, of course, do not require such big doses of santonin.

Thread Worms (Fig. 45). Thread worms are small white worms, which occupy the lower part of the bowel, where they cause intense itching. They may exist in thousands. Children are the most common sufferers. A teaspoonful of common salt in a quarter of a pint of tepid water injected



FIG. 45.—THE THREAD WORM.

into the bowel is a useful and simple remedy. The bowel should be made to empty itself before using the injection.

Tape Worms (Fig. 46). Tape worm is not a very common ailment in India. It is caused by eating diseased and undercooked meat, such as pork. The worms exist chiefly in the small intestine. They may be very many feet in length. They have a head about the size of that of a small pin. They are flat in shape, and about one quarter of an inch to half an inch broad. The proper treatment for tape worms is to first thoroughly empty the bowel with castor oil and abstinence from food, and then to take a dose

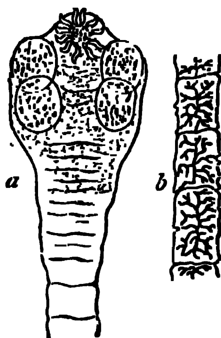


FIG. 46.- THE TAPE WORM. (*a*) its head (magnified); (*b*) joints (natural size).

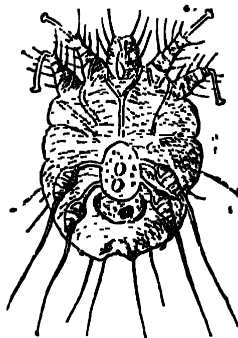


FIG. 47.—THE ITCH INSECT.

of the extract of male fern. Those who suffer from worms of any kind should, however, consult a doctor privately, or if poor should go to the nearest charitable dispensary for advice, as diseases of this kind require special treatment.

Itch (Fig. 47.) This is a disease which is to be found chiefly between the fingers and toes. It may also, however, attack the hips, wrists, and other parts of the body. It is caused by a small insect which burrows under the skin, where it lays its eggs, and where the young insects are hatched. Like ringworm, it causes intense itching. The

disease is spread from one part of the skin to another by this means, and it is also conveyed from person to person by direct contact, as in shaking hands. The little tunnels under the skin, and the spot where the eggs are deposited, can be seen with the naked eye. In bad cases of the disease painful sores may form, and the whole of the toes and fingers may become one mass of scabs.

Treatment. The best remedy is sulphur, which kills the insect, and thus cures the disease. It should be applied at night to the parts affected; or, if the disease has spread extensively, it may be necessary to apply the sulphur to every part of the skin from the neck to the toes. A hot bath should be taken before doing so. One ounce of sulphur in powder mixed with four ounces of ghee makes a good ointment for the treatment of itch. It should be applied every night for three or four nights. No clothing which has been worn by the sufferer should be again used after the disease is cured until it has been thoroughly boiled.

Lice (Fig. 48), are too well known to need description. They are found chiefly in the head, but also in other parts of the body. They cause great irritation, and often severe inflammation of the affected parts. The animals themselves are easily killed, but their eggs, which stick to the hair, are very difficult to destroy.



FIG. 48.—*a*, the head louse; *b*, nits on hair (magnified); *c*, same (nat. size).

Treatment. Mercury ointment and carbolic acid are the best remedies. These may be obtained at a chemist's shop or charitable dispensary. The

use of combs helps to get rid of the insects and their eggs. Cleanliness is the best means of prevention.

Ringworm of the Body (Fig. 49). This disease is known under various Indian and English names. Moore gives the following:—"Dad, dadru, majee's dad, denaii, dhobi's itch, washerman's itch, Malabar itch, and Burmese ring-worm." The disease is caused by a vegetable parasite, which resembles in appearance and growth the mould which grows on walls, books, boots, and other articles which are allowed to lie neglected in dark and damp places. The disease attacks chiefly the inside of the thighs and parts in the neighbourhood, also the back, belly, armpits, and even the face, scalp, roots of the nails, and other parts of the body. It causes intense itching, and the desire to scratch the part is irresistible. It is most troublesome at night. It prevents sleep, makes life miserable, and undermines the health.

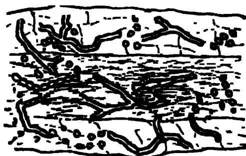


FIG. 49.—RINGWORM FUNGUS IN HAIR.

Treatment. Moore recommends Goa powder mixed with lime juice or vinegar to form a paste, which should be well rubbed into the part at night for several nights in succession. The diseased part is thus bleached white, while the surrounding healthy skin assumes a deep, brownish-red colour, and becomes very tender. The redness and tenderness soon disappear when the treatment is stopped. When this powder is used old underclothing should be worn, as the drug stains clothing badly. Iodine is also useful, and may be applied with a feather daily till the skin becomes very tender or until blisters form. Strong carbolic acid solution of 10 grains to the ounce of water applied with a brush may also be tried. A very

good remedy is whisky or country liquor. This may be rubbed into the diseased parts with a piece of rag until the skin almost begins to bleed. This is sufficient at times to cure the disease. The application of Goa powder afterwards, however, will make a cure more certain. Mercurial ointment has also been tried. Goa powder or medicines derived from it are, however, best of all.

Diarrhoea. Diarrhoea is looseness of the bowel. The most common causes of diarrhoea are bad food, tainted fish and meat, unripe or over ripe fruit, uncooked or badly cooked vegetables, polluted water, impure air, and chills. Malaria often causes diarrhoea, and, as has been already stated, diarrhoea is one of the chief symptoms in cholera and enteric fever. It is often accompanied with severe pain, sickness, and vomiting. If it is caused by eating bad food, the patient may be made to vomit and a dose of castor oil given with benefit. If it is due to any other cause, such as a chill, opium or chlorodyne may prove useful remedies. Laudanum is the best form in which to give opium. It should be given with great care, and more especially, as has already been pointed out, in the case of infants. The diet should consist of milk, rice, arrowroot, bread and milk. Food of this kind should be given in small quantities often. The patient should be kept lying down. The belly should be kept warm. A flannel bandage or kummerbund is useful for this purpose. When cholera is prevalent, diarrhoea should be attended to at once.

Fainting. Fainting is due to weakness and sudden failure of the action of the heart. The patient becomes pale, a cold sweat breaks out on the face, the pulse becomes weak and fast, and vomiting may take place. The attack does not last long. Sudden severe pain, such as is caused by a severe sprain, often causes fainting.

Treatment. Pure fresh air is the best remedy. The

patient's feet should be raised, and if the fainting takes place while the person is sitting, the head should be bent forward between the knees. The dress worn at the time should be loosened, cold water may be applied to the face, smelling salts to the nose, and a little brandy, sal volatile, or other stimulant may be given.

Apoplexy. This disease occurs as a rule in old people. It may occur in middle-aged persons, whose blood-vessels are, from any special cause, diseased. It is due, as a rule, to a bleeding into the brain owing to one of the blood-vessels having ruptured.

Symptoms. The attack comes on suddenly. The patient loses the power of one side of the body. He may be unconscious and unable to speak. His breathing is heavy and noisy.

Treatment. The patient's head should be slightly raised. No stimulants of any kind should be given. The room in which the patient is should be kept dark and quiet. No noises of any kind should be allowed. Cold should be applied to the head. The feet should be kept warm. A mustard plaster may be applied to the back of the neck.

Epilepsy. Suddenly, without warning at times, persons who suffer from this disease give a shriek and fall to the ground. It has for this reason been called "falling sickness." They froth at the mouth, and if the tongue is bitten, as it often is during attacks, the froth may be stained with blood. The face turns blue. The muscles of the body are at first rigid or stiff, and then become convulsed. The patient is unconscious, and knows nothing about what is going on around. Breathing is noisy. The fall is the most dangerous occurrence in this disease. The disease may be caused in very many different ways. Children when getting their teeth, or who suffer from worms in the bowel, often get fits of this nature.

Treatment. The clothing of the patient should be

loosened, especially about the neck, so as to make the breathing easier. A piece of cork or wood should be put between the teeth to protect the tongue. The patient should be put on his back. It does no good to throw cold water on the face or give anything to drink. The attack will soon pass off if the patient is kept quiet and allowed plenty of fresh air. When children get fits of this kind, a hot mustard bath and application of cold to the head is the best treatment.

Bleeding. Blood may escape from either an artery or a vein. The blood from an artery is bright red, and escapes in jets with every beat of the artery when a vessel of this kind is wounded. Blood from a vein is of a dark purplish colour. It does not spout out in jets, but has a steady and constant flow. It can be stopped much more easily than bleeding from an artery. The loss of blood, of course, will depend upon the size of the wound or injury, and the size and importance of the artery or vein which is wounded.

How to stop Bleeding. The finger, a pad, a piece of sponge, a piece of cork, or something of that kind may be firmly applied to the spot from which the blood comes. When the bleeding is from a vein, the limb should be raised, and pressure applied over and below the wound. If from an artery, pressure should be applied above the wound. The pressure must not be applied too long or the parts pressed upon will die. Cold water may be used. Water as hot as the hand can bear is, also, sometimes used to stop bleeding. Medicines are often applied to the bleeding spot to cause the blood to clot, and thus stop further loss. Medicines are also at times taken inwardly. The ends of the wounded vessels have sometimes to be tied.

Bleeding from the Nose should be treated by applying cold to the back of the neck and nose, raising the arms,

and holding the head back. The nose has sometimes to be plugged with cotton-wool. **Bleeding from the stomach or lungs, and other forms of internal bleeding,** should be treated by making the patient lie down. The patient should be kept quiet, and should not be allowed to talk. Small pieces of ice may be given, and ice may be applied over that part of the body from which the bleeding is believed to come. A doctor should be sent for, as cases of this kind are always serious.

Treatment of the Patient. If a person loses much blood fainting may occur, and even death may take place. In cases of fainting smelling salts may be used. The lips should be rubbed with stimulants, such as brandy, ether, ammonia, or camphor may be given inwardly. Brandy may also be given. Medicines, however, can only be used safely and wisely under the advice of a doctor. In all cases of severe bleeding skilled help should be sent for without delay.

Injuries and their Treatment. Bleeding from injuries of the skin or deeper tissues of the body should be stopped. The part should be thoroughly cleaned. Carbolic oil, made of one part of carbolic acid and twenty parts of linseed or olive oil, applied on a piece of rag is a good dressing to use. The chief object is to keep the parts clean. If the wound is very large, or if there are any signs of broken bones, the patient should be kept quiet, and surgical aid sent for.

Bruises are accompanied by swelling, blueness of the injured part, and pain. The blueness is caused by the rupture of some of the small blood-vessels, and the escape of blood therefrom into the surrounding parts.

Treatment. Rest and the application of cold at first, and warmth afterwards, is the proper treatment. The part should be raised.

Sprains. The joints are the seat of injury in sprains. They are caused by the sudden twisting and tearing or rupture of the ligaments which support the joints. Swelling takes place all round the joint.

Treatment. Rest, pressure with a firm bandage, and heat are the best form of treatment at first. If the swelling and pain continue to increase, the pressure should be removed. When the pain and swelling begin to pass away oil or some liniment should be applied, and the part well rubbed with the hand. Gentle movement of the joint is good at this stage, for if the joint is kept at rest too long it will become stiff.

Broken Bones. When bones are broken the injured part should be kept at rest and in a straight position until surgical help arrives.

Dislocations. Bones which are out of position are said to be dislocated. Surgeons only should be allowed to treat such cases.

Sunstroke is caused by exposure to the rays of the sun, overcrowding, intemperance, too hard exercise, and exhaustion.

Symptoms. Faintness, sickness, and vomiting may usher in the attack. The pulse is rapid and weak The breathing is hurried and noisy. The patient complains of intense headache and giddiness. The skin becomes very hot, the face is flushed, and the patient may become unconscious. The temperature may rise to a great height, the heart suddenly fail, and the patient die. Death may take place very soon after the attack, or the patient may live for a day or two. Recovery takes place in about fifty cases in every hundred. It often happens that patients after recovery continue to show nervous symptoms.

Treatment. The patient should be made to sit up. Cold in the form of ice in ice bags, if at hand, should be applied to the head, the back of the neck, and the chest; or the

coldest water that can be got should be poured over the head from a height. The patient should then be dried and well rubbed with the hands. A mustard plaster applied to the back of the neck also does good. If fainting takes place, stimulants should be given. Ice-water, or water as cold as can be got, when drunk, is a safeguard against sunstroke.

Prevention of Sunstroke. This can best be secured by protecting the head and the back of the neck with a thick covering. In India and other hot countries, solah topies and puggrees are largely used for this purpose. Thick pads should be worn to protect the backbone or spine, and sun-glasses to protect the eyes from glare Overcrowding, intemperance, too hard exercise, and exhaustion should be avoided.

Burns and Scalds. Burns are caused by dry heat, such as a hot iron. Scalds are caused by moist heat, such as steam or boiling water. Injuries of this kind are very dangerous, more especially in the case of old persons and children. The larger and deeper the injury the greater the danger. Death from shock often follows severe burns and scalds. The patients sometimes die from diseases of internal organs following such injuries.

Treatment. First, remove the object that may be causing the burn or scald, or remove the patient. If the clothes are on fire the patient should be made to lie down, and covered with a blanket or other thick covering, to put out the flames. Water is also useful, and in the case of oil flames, sand.

The burn or scald should be immediately covered up with cotton, wool, or a thick layer of rags dipped in carron oil to keep out the air. Carron oil is made of equal parts of linseed oil and lime water. If no linseed oil is at hand olive oil may be used instead. The wool or rags will stick

to the burned or scalded part unless kept well soaked with the oil. Oil is also useful in helping to remove any of the clothing that may be sticking to the part. After the first two days or so, carbolic oil of the strength already stated will be found useful in treating the affected part. If the patient suffers from faintness, stimulants should be given and the feet kept warm.

FOREIGN BODIES IN THE EYE, EAR, NOSE, AND THROAT.

The Eye. Foreign bodies in the eye, such as flies, dust, particles of charcoal, and so forth, can be best removed with the corner of a handkerchief, or clean, lukewarm water may be allowed to flow into the eye. A drop of sweet oil is useful when anything burns the eye. The eye is a very delicate and sensitive organ, and with the exception of simple cases, such as those mentioned above, all cases should be treated by a doctor who has made it an object of special and careful study.

The Ear and Nose. Children often put small objects, such as slate pencil, peas, beads, and the stones of fruit into their ears and nostrils, where they often remain for years. Peas have been known to sprout in a child's nose. Insects find their way into the ear sometimes, and give rise to much alarm. Rough treatment might push the foreign body further into the ear or nose Severe bleeding from the nose might take place. The ear is still more delicate, and attempts to remove foreign bodies might injure the drum of the ear, or set up severe inflammation. Careful syringing of the ear with lukewarm water is the best way of trying to remove foreign bodies. The syringe should always be pointed slightly upwards towards the top of the patient's head, and the outer ear should be pulled backwards and

downwards to open up the canal. A drop or two of oil poured into the ear is sufficient for insects. Foreign bodies are sometimes very easily removed from the nose. It is always safest and wisest, however, to send for the doctor. Upon no consideration should Indian barbers be allowed to interfere with the ear. Abscesses are frequently caused through their rough handling of this delicate organ.

The Throat. Foreign bodies in the throat of a child may be removed by holding the patient up by the heels and tapping the back sharply. The inside of the throat may be tickled. It is sometimes necessary and useful to cause vomiting. Sometimes the foreign body, such as a fish bone, can be seen and easily removed with the fingers. Even when not seen the foreign body may be within the reach of the fingers, and in this way can sometimes be removed. Foreign bodies, which stick in the gullet or food pipe, can sometimes be forced downwards by swallowing a piece of boiled potato or bread well chewed. Recourse to the help of a surgeon, however, cannot be avoided now and again, and he should be sent for at once in cases in which the life of the patient is in danger, or the foreign body cannot be displaced. He only can adopt other measures which are sometimes found necessary.

Snake Bites. Some snake bites are harmless. Others are deadly poisonous. If there is any doubt on the point, the best thing to do is to treat the bite as a poisonous one. A piece of string should be tied firmly above the seat of the bite, and other pieces at short distances one above the other. The ligatures should not be kept on too long, or, as was said when dealing with bleeding, the part will die. If there is no wound about the lips or inside the mouth, the wound may be sucked. The mouth and lips should afterwards be well washed and disinfected. Bleeding from the part which is bitten should be encouraged. Wounds may

be made with a small knife to cause free bleeding. The bitten part may be, and sometimes is, cut out. Fingers even have been amputated. The wound may be burnt with a hot iron, or some strong acid such as nitric or carbolic acid may be applied. Ammonia in the form of sal volatile should be given freely as a stimulant Brandy is also good in cases of this kind. The use of what is called anti-venom serum has been attended with good results in many cases of snake bite. In snake bites, as in other serious cases, a doctor should be called in to treat the patient.

Stings. The stings of wasps and other similar creatures can best be treated by applying a strong solution of ammonia to the part. This stops the itching caused by formic acid, which is introduced into the skin through the sting. Soap is sometimes used. It should be applied to the part freely. Glycerine and oil are also useful. If the sting is left in the skin, it should be removed. The stings of some of these small animals, such as wasps, if numerous, may be dangerous to the life of the patient. If the symptoms are severe, it may be necessary to give the patient stimulants.

Drowning. In cases of drowning, sand or other foreign matter should be removed from the mouth and nose. The clothing should be loosened. The tongue should be pulled forward, and the patient kept warm. The body should be well rubbed, and warm bottles put to the feet, legs, and other parts of the body to secure this object. Artificial respiration should be resorted to and continued for an hour, or even longer, until the patient begins to show signs of reviving. Patients have been known to begin to show signs of life after artificial respiration had been carried on for five hours.

How Artificial Respiration is performed (Fig. 50). Get

two pillows or two bundles of clothes. Put the patient on his back, with his shoulders resting on one pillow or bundle of clothes and his neck on the other. The head should be slightly bent backwards. The mouth must be kept wide open, and the tongue pulled well forward. Grasp the patient's arms above the elbows. Draw the arms slowly above the head, thus raising the ribs and causing the lungs to fill with in natural breathing. Slowly lower the

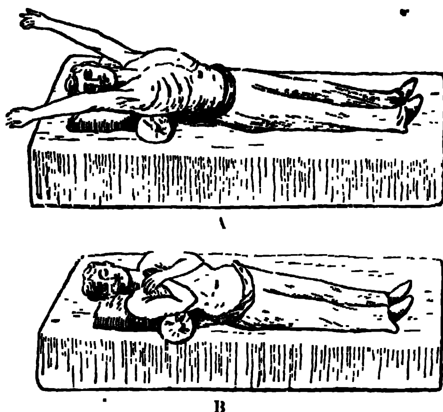


FIG. 50.—ARTIFICIAL RESPIRATION. Position of inspiration, A; of expiration, B.

arms again, and press them against the chest walls. These two movements of raising and lowering the arms should be performed about 16 or 18 times each minute.

Strangulation. Death takes place from strangulation in the same way as from drowning. The cord, the piece of cloth, or whatever is round the neck, keeps the air from entering the lungs, and the patient dies from suffocation.

Treatment. The first thing to do is to remove whatever constricts the neck and give the patient fresh air. Cold water should be dashed on the face or other parts of the

body. The patient's forehead and chest should be well slapped with a wet towel. Artificial respiration may be needed.

Suffocation. This may be caused not only by hanging, but by covering up the mouth and the nose. Young children are often found dead in bed, having been accidentally suffocated by blankets and pillows. Foul gases, such as coal-gas and the fumes of charcoal and other substances, often cause death in this way. Cases of this kind should be treated like cases of strangulation.

Poisoning. Treatment. The first thing to do is to remove the poison from the patient's stomach where this is advisable and possible. The stomach pump is useful for this purpose, but is safe only in the hands of a medical man. Medicines are sometimes given to make the patient vomit. Mustard, salt, and warm water are useful for this purpose. The quantities used for grown up people are one tablespoonful of mustard flour, one teaspoonful of common salt, and twenty tablespoonfuls of warm water. A teaspoonful of mustard and a quarter of a teaspoonful of salt in half a tumblerful of warm water will be enough for children. The patient should drink it all. Vomiting should take place a few minutes afterwards. Tickling the inside of the throat will sometimes bring about the desired result. In cases of poisoning with sulphuric acid (oil of vitriol) and other acids of this kind, the white of egg, milk, chalk, the plaster of walls, and olive oil are among the best substances to give. When acids have been swallowed the patient should never be made to vomit on any account, otherwise the pain and burning in the stomach, food pipe, and mouth will be aggravated. In cases of carbolic-acid poisoning eggs, milk, oil, and stimulants are best. Such substances as caustic soda, caustic potash, and ammonia are sometimes taken accidentally or intentionally. In these cases vinegar

and water or lemon juice and water should be given, and afterwards sweet oil. The same rule should be followed in these cases as in cases of poisoning by acids, that is, "never make the patient vomit." In opium poisoning, a very common form of poisoning in India, the patient should be made to vomit at once. He should be kept moving about, otherwise he will fall asleep and perhaps die while in this state. If cold, he should be kept warm by rubbing his body and by the application of hot-water bottles. Strong coffee is useful. Artificial respiration is sometimes required. In poisoning by dhatura, hemlock, morphia, and hemp, the treatment is the same as in cases of poisoning by opium.

APPENDIX.

RULES AS TO DESKS AND SEATS.

Mr. Priestley Smith says (*Ophthalmic Review*, June, 1886):—

"Much ingenuity has been devoted to the construction of school desks and seats, and very many different models, each claiming some advantages, have been publicly exhibited during the last few years. At the request of the Midland Educational Company, I have lately designed a School desk which embodies the recognised essentials in as simple and inexpensive a manner as seems to me to be possible. These recognised essentials are as follow:—

"1. The seat must be of such height as will allow the scholar's feet to rest flat upon the floor or footboard, and broad enough to support the greater part of the thigh.

"2. The seat must have a back placed at such height as to fit the hollow of the back below the shoulder blades, and support the body in a vertical position.

"3. The near edge of the desk must be just so high above the seat that when the scholar sits square and upright with elbows to the sides, the hand and forearm may rest upon the desk without pushing up the shoulder.

"4.—As used in writing, the desk must have a slope of 10° to 15° (about 1 in 5); as used in reading, it must support the book at an angle of about 45°, and at a distance of at least 12 in. from the eyes—16 in. is better (30—40 cm).

"5.—As used in writing, the edge of the desk must overhang the edge of the seat by an inch or two, in order that the scholar shall not need to stoop forwards, and that the support to the back may be maintained.

"6.—Either the desk or the seat, or some part thereof, must be movable at pleasure, so that although the desk usually overhangs

the seat, the scholar may be able at any time to stand upright in his place.

"7.—The desks and seats must be of various sizes, in order that the foregoing conditions may hold good for scholars of various ages.

"Adopting with little alteration the proportions given by Snellen for the various parts of his desk, I have, for the sake of convenience and economy, slightly altered the progression, and reduced the number of sizes to four. Instead of advancing by increments of one-tenth, which is doubtless the right method from the theoretical point of view, I divide the scholars according to their heights into four classes advancing in each case by six inches; thus 3 ft. 6 in. to 4 ft., 4 ft. to 4 ft. 6 in., 4 ft. 6 in. to 5 ft., and 5 ft. to 5 ft. 6 in. The dimensions of the desks are suited to these four heights. The table on the following page gives the dimensions of my desk the 'Hygienic Desk,' Nos. 1, 2, 3, and 4.

"Its general construction is shown in the subjoined figures. The standards and the cross pieces which unite them are of cast iron. The back, the seat, the top of the desk, and the shelf beneath are of wood. The only points which require description are, the book-rest, and the arrangement by which the desk is made movable at pleasure.

"The flap which supports the book does not extend the whole width of the desk, but occupies the middle portion only, leaving room for an ink-pot to be let into the wood at the side of it. The flap when in use is supported by a small stop which hangs from its further edge, and which, though quite firm, can be pressed back by a touch of the finger when the book-rest is no longer wanted. The flap is pivoted in such a way that its near edge sinks below the surface of the desk when the flap is raised, and thus creates a groove for the book to rest in.

"The wooden top of the desk is screwed to two sloping cast iron brackets which pass from back to front, one at each side of the desk. Each of these brackets carries beneath its lower or horizontal border a round iron rod, the two ends of which are fixed to the bracket. The rods slide freely through holes or eyes on the upper surface of the standards. By this means the desk is able to slide upon the standards in a direction towards and from the scholar. When the desk is pulled forward a notch in the near end of each rod engages with the eye in which the rod slides, so that the desk is secured in

this position, and is not liable to slide away from the scholar if he leans against it. By lifting the front edge of the desk the notches are disengaged and the desk is easily pushed back, so that the scholar can stand up in his place. This is a mechanism which does not get out of order, and which cannot injure those who use it, or be injured by them. The whole desk can, I believe, be made at a cost not much greater than that of many of the old-fashioned un-hygienic patterns now in use."

"HYGIENIC DESK."

HEIGHT OF SCHOLARS	No. 1. 3ft. 6in.—4ft. 107-122cm	No. 2. 4ft. —4ft. 6in. 122-137cm.	No. 3. 4ft. 6in.—5ft. 137-152cm.	No. 4 5ft.—5ft. 6in 152-168cm.
a Height of seat from floor	13in. 33cm.	14½ 37	16 41	18 46
b Breadth of seat	10 25·5	11 28	12 30·5	[illegible] 33
c Height from seat to edge of desk	8in.	8¾	9½	10½
c Height from seat to top of back	20cm.	22	24	26·5
d. "Overhang" of desk	1 2·5	1 2·5	1½ 4	1½ 4
e. Play of desk	4½ 11·5	4½ 11·5	6 15	6 15
f. Breadth of desk (front to back)	15 38	15 38	17 43	17 43

Slope of desk 1 in 5.

Mr. T. G. Rooper (H.M. Inspector of Schools) says:—

1. THE DESK AND BENCH.

"1. The height of the desk above the bench should be such that when the child is sitting down, he can place both his forearms comfortably on the desk, without raising or depressing his shoulders.

"2. The height of the desk above the floor or surface on which the foot rests, should correspond with the length of the child's leg from knee to heel. When the child is sitting down, his legs should not dangle in the air, nor should his knees be elevated above the bench.

"3.—The bench should be wide enough to give support not only to the seat, but also to the upper part of the thigh. It should be at least 10 inches (but better 12 inches) wide. To prevent slipping forward, the bench should be hollowed out towards the back to the depth of an inch.

"4.—Every bench should provide a support for the back of the sitter. This may consist of a board fixed at the back of the bench, at right angles to the seat. The board should be hollowed out in such a way that the upper part of it may fit the concavity of the back. The exact height of the back would vary with the size of the child, but it will be from 6 to 7 inches.

"5.—The desk must overhang the bench during the writing lesson, in order that the child may be able to sit upright, and at the same time support his back. This posture is only possible when the desk overhangs the bench from 1½ to 2 inches.

"6.—The desk should not be level for the writing lesson, but slightly sloping. The slope should not exceed an angle of 20 degrees. The difference between the upper and lower edge of the desk, therefore, should be about three inches vertically.

"7.—As the desk, which is most suitable for writing, is inconvenient for other purposes, the easiest plan of adapting it to all uses is to make the upper part of it movable.

"8.—Desks of appropriate sizes should be provided for each class.

2. The Posture in Writing.

"1.—The writer should sit upright, and should lean his back against the support provided for the purpose.

"2.—The shoulders should be kept parallel with the edge of the desk. The writer must not be allowed to screw the body round or to rest the chest against the desk. There should be a space of an inch or a little more between the desk and the body.

"3.—The weight of the body should be disposed evenly on both bones of the seat.

"4.—The head should not droop forward, much less lean on the arm. It may be slightly bowed forward, and may move a little from side to side as the eye follows the writing.

"5.—The forearms, and not the elbows, should rest on the desk. The pen should be passed across the paper by a movement of the hand and not of the arm.

"6.—The point of the pen should be at least ten inches (better twelve) from the eye.

"7.—To make compliance with the above directions possible, the paper or copy-book must lie opposite to the middle of the body.

"8.—The paper must not lie square on the desk before the writer but it must be tilted or askew.

"The lower edge of the paper and the lower edge of the desk should form an angle of from 30—40 degrees.

"The paper is rightly placed when the down strokes are being made at right angles to the edge of the desk.

"The common attitude for writing often ordered by teachers with the words, 'Half turn right, left arm over slates,' is liable to cause injury both to the spine and to the eyesight."

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